SCIENTIFIC AMERICAN

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THE SANDY HOOK MORTAR BATTERIES.

There was a time, and it was not very long ago, when a hostile fleet could have silenced the forts which defend the harbor of New York and either bombard the city or exact a heavy ransom. A few years ago the upper part of the long, low peninsula called Sandy Hook was a wilderness covered with scrub pines and was used as a lighthouse station, the only defenses of this entrance to the harbor being a few smooth-bore cannon. The same conditions existed at Forts Hamilton and Wadsworth, at the Narrows, and at Fort Schuyler on Throggs Neck, and Willets Point on the Sound. The fortifications were imposing, and seemed capable of doing untold damage to an unfriendly fleet, but this appearance was deceptive, and the modern rifles of war vessels would soon have silenced them.

New York was naturally one of the first places to be considered when the question of coast defense arose, and in the last five years these conditions have all been altered, though there are few outward signs of these changes. Instead of the city being at the mercy of a small fleet of modern war vessels, it would now be practically impossible for a squadron to damage the city by trying to bombard it from outside Sandy Hook and an attempt to enter the harbor, either from the channels leading to it from the sea or through Long Island Sound, would undoubtedly prove fatal to even the most powerful vessel.

Among the sand dunes and scrub pines at the end of Sandy Hook have been constructed the strongest fortifications on the American continent. The picturesque old smooth-bores at the forts at the Narrows have given place to modern guns, and improved batteries guard the approach to New York by Long Island Sound. The work has progressed to such an extent that at present the city is almost impregnable, and this work has been done with considerable secrecy.

The subject of our first page engraving is the breech-loading mortar battery at Sandy Hook, which supplements the splendidly equipped Fort Hancock. There are two mortar batteries at Sandy Hook available for

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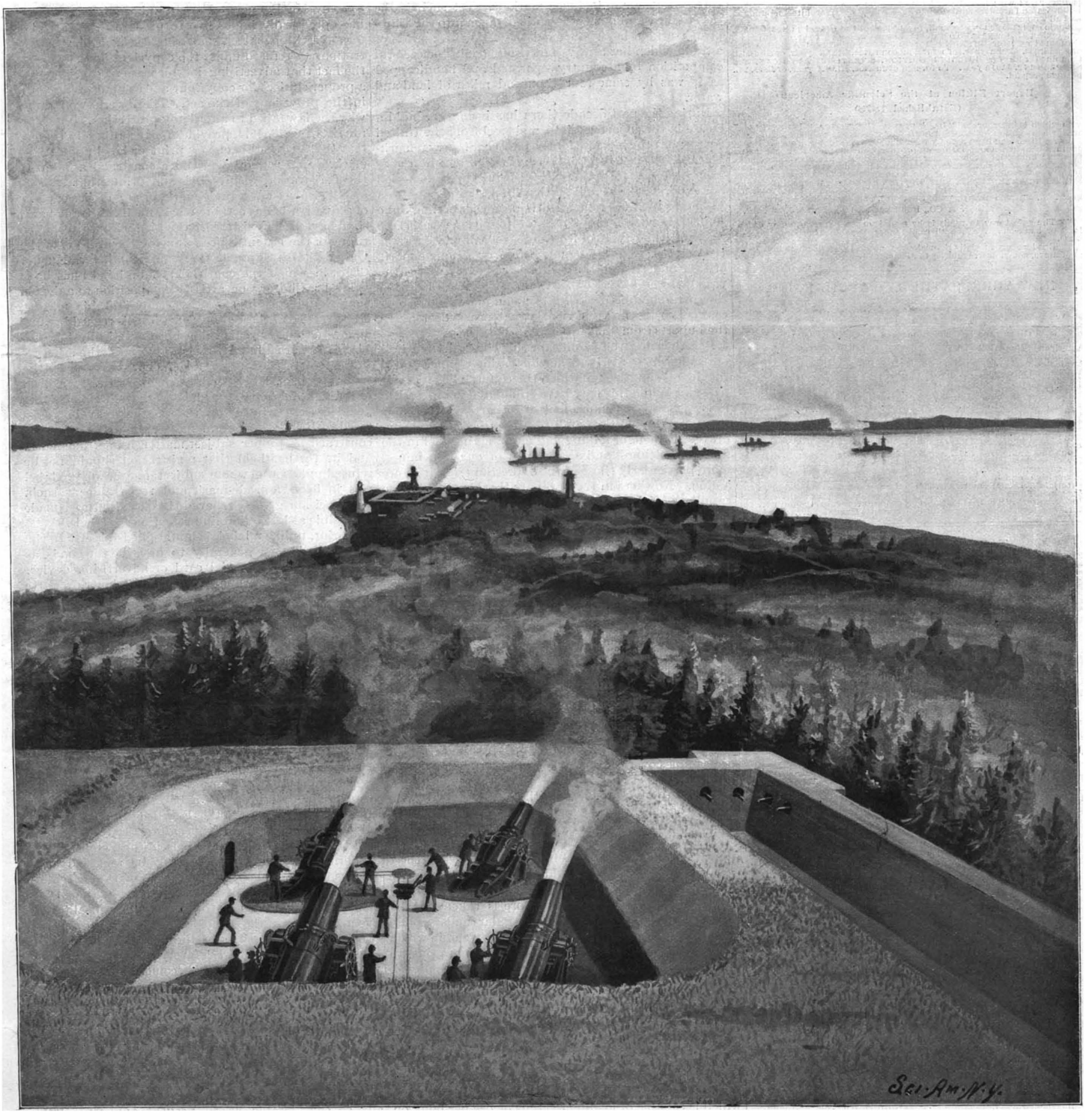

THE DEFENSE OF NEW YORK HARBOR—A QUARTER OF THE MORTAR BATTERY No. 1A IN ACTION.

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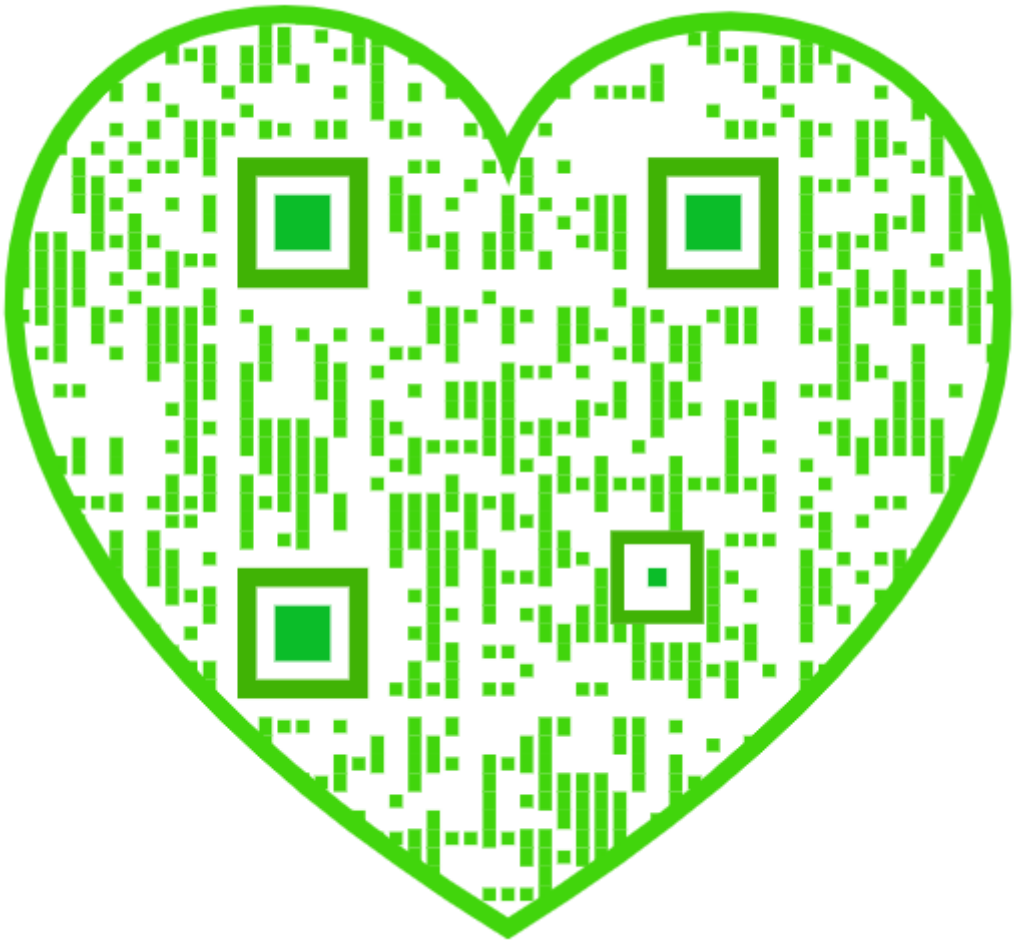

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NEW YORK, SATURDAY, APRIL 16, 1898.

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AMERICAN SUPREMACY IN THE IRON TRADE.

It is a significant fact that while it is a recognized feature of our foreign policy that as a nation we should abstain from all interference in European affairs, the course of events is demonstrating that the time is coming, and coming rapidly, when, by virtue of our expanding trade and growing commercial influence, we shall be forced to take a hand in the commercial strife which is, happily, taking the place of the sword in the world's international rivalries.

The Eastern complication is a trade dispute, pure and simple, and whether her motives be disinterested or not, there is much truth in the contention of one leading party to the dispute, that the rapidly expanding trade of the United States should render her deeply interested in the threatening partition of China.

Time was when the vast area and undoubted resources of the unoccupied territory of the United States seemed to justify the statement that we were commercially a self-contained people; that the work of developing the country would give ample employment for all the industrial works which were rapidly springing up throughout the Eastern States. He would have been reckoned a bold prophet who, a generation ago, might have dared to predict that, in the iron trade, for instance, we would, within twenty-five years, not only be capable of supplying our own enormous demand, but would be making successful inroads upon the European trade in its home markets. Yet such is the case to-day, and our successful entrance into the European markets has challenged the serious attention of a trade which has always felt secure against successful competition by a country separated and handicapped as it was by some four thousand miles of land and water.

During the past decade there has been a gradual increase in the exports of iron and steel from the United States; but the increase for the past year is very remarkable. From 1886 to 1896, the exports of pig iron rose from 7,659 tons to 29,862 tons. During the same period our exports of iron and steel railroad bars rose from 3,969 tons to 27,645 tons. During the year ending June 30, 1897, however, the export of pig iron was 168,890 tons and the export of iron and steel railroad bars was 112,172 tons. The aggregate value of all our exports of iron and steel to Europe during nine months of the year 1897 was $45,693,000, as against $34,549,000 during the corresponding period of 1896—an increase of 33 per cent. During the same months there was a decrease in the imports from $16,361,000 to $10,032,000.

In estimating the significance of these figures, it is not sufficient to attribute our increasing competition to the depression through which the country has recently passed. While this may have stimulated us to seek a foreign market, we must look to other causes for our successful competition, and these are to be found in improved methods of mining and manufacture and in the unrivaled richness and accessibility of our iron mines, more particularly those of the Lake Superior iron ore region. Nowhere in the world are there such extensive supplies of rich and easily worked ore as are found in this district, and unless similar ore beds are discovered in other countries, we shall possess an advantage which bids fair to fully offset the cost of transportation in competing with European manufacturers.

The Lake Superior ores possess a fourfold advantage: (1) They are extremely rich in iron; (2) they carry a remarkably low percentage of phosphorus; (3) the ore beds are so situated that the cost of mining is low, being reduced in some cases to a theoretical minimum; and (4) the deposits are of vast extent. In regard to the richness of the ore, it is sufficient to say that out of nine grades of ore mined in the Vermilion Range, two show over 67 per cent, three show between 64 and 65 per cent and none less than 60 per cent of iron; in the celebrated Mesabi Range the percentage runs from 59 to 65·5 per cent; in the Marquette Range most of the ore samples over 60 per cent of iron and some of it as high as 67·62 per cent.

Coupled with its richness is the invariably low percentage of phosphorus, which renders it so amenable to the Bessemer process. The proportion rarely runs over 0·1 per cent, and in some cases falls below 0·01 per cent, the average percentage being about 0·06. To these great advantages must be added the fact that the disposition of the ore beds is such that the cost of mining is reduced to a minimum. The ore is taken out by three systems, the first being the regular underground mining. The second is the "milling" system, in which shafts are sunk, drifts are completed, raises are put up to the top of the ore and chutes are put in at the level. The ore body is then drilled and blasted into the chutes. In the third system the mines are worked as open quarries, the ore being dug up by powerful steam shovels and loaded directly onto the cars. In the earlier stages of the open quarry system, the loaded cars are run out of the mine by gravity. The shovels are of great size, weighing in some cases as much as 80 or 90 tons. On the Mesabi Range a 90-ton shovel is at work which is capable of loading 500 tons of ore per hour on the cars at a cost of 15 cents per ton. Even greater records are claimed where the conditions are favorable, and the cost is said to have been brought down in such cases as low as 10 cents per ton.

As to the extent of the Lake Superior deposits, it is sufficient to give the figures of production. The first mines of this district were opened some forty years ago, and the total output of the most celebrated ranges, with the dates of their opening, are as follows: Marquette opened 1856, output to January 1, 1897, 46,538,187 tons; Menominee, 1880, 22,994,428 tons; Gogebic, 1884, 20,788,787 tons; and the Mesabi, although opened only in 1892, has produced in five years no less than 8,074,583 tons of ore. This mine alone gives indication of containing some 400,000,000 tons of ore, half of which, at least, contains 60 per cent of iron and only 0·06 per cent of phosphorus.

If we were content to rest satisfied with the extraordinary richness and suitability of this princely storehouse, we should be formidable competitors in the world's trade; but when to this is added a ceaseless and successful endeavor to cheapen the cost of mining, transportation and manufacture, it can be seen that our world-wide supremacy is merely a matter of time.

NEW BILLS FOR THE REGULATION OF PRINT AND LABEL REGISTRATION.

Two bills for regulating the registration of prints and labels have been introduced into the House, H. R. 8620, fathered by Mr. John Murray Mitchell, and H. R. 8582, by Mr. Bennett. For a number of years it has been practically impossible to procure any protection for advertising matter, such as labels or prints. Registration was refused under the copyright laws, owing to the fact that advertising matter was not considered as a proper subject for copyright and as not coming within the provisions of the act. There were two reasons why the law failed to afford any protection. The statute of June 18, 1874, provides for recording in the Patent Office "the title of any print or label not a trademark." This the Patent Office construed as a bar to the registration of all labels and prints that contain any device used as a trade-mark, or any device capable of sequestration as a trade-mark, until the trade-mark shall have been registered. Coupled with this was the ruling of the Patent Office following the decision of the United States Supreme Court in Higgins v. Kueffel (1891), in which the court held that a label must have value as a literary or artistic composition to a degree that would sustain any other copyrightable matter. The practice of the Patent Office in this regard became so severe that for years it has been practically impossible to prepare a label that would fulfill the exact requirements of the Patent Office. The provision for the registration of labels had become practically a dead letter. In February, 1898, however, the Commissioner decided (ex parte Mahn) that a label may be registered although it contain matter that is or might be construed as proper subject matter for a trade-mark, and he further held that registration should not be refused unless the whole subject matter of the label was in itself a trade-mark and registrable as such. This decision greatly relieved the situation and made it possible at last to obtain protection for labels.

A print, unlike a label, is not applied directly to the goods, but is used generally to describe the goods, as in the case of a pictorial card or advertising device. Until the recent decision of the Commissioner ex parte United States Playing Card Company, the presence of any device of a nature that might be construed to constitute a trade-mark was not registrable, in spite of the fact that it was evident that a print is not affixed to the goods, and until affixed could not be considered a trade-mark. These rulings resulted in hardship to the manufacturer or merchant, as well as to the artist or lithographer, and the refusal to register such subjects because they might contain subject matter that could be considered as a proper subject for a trade-mark was a great injustice.

These pending bills seek to bring order out of chaos by providing that the presence of a trade-mark in a print or label shall not be a bar to registration, and thus give added force to the late decision of the Commissioner by insuring a uniform practice touching the registration of prints and labels in the Patent Office. Modern advertising has come to be regarded as a science, and the talent of our best artists is often invoked to produce results which will arrest the attention of the public and at the same time appeal to the eye and feeling of the beholder. It seems unfair that it has not been possible in the past to protect fully such productions. There is every reason why one or the other of these bills should become a law, and it is to be hoped that the favorable consideration of Congress will be obtained.

Bill No. 8582 contains a provision which is not included in bill No. 8620, and which we think is very important. Under the present practice it is impossible to procure protection for a pack of playing cards without registering with the Librarian each card separately as an engraving, the expense of which is generally so considerable as to prevent applicants from seeking this form of protection. Furthermore, the Librarian often refuses registration on the ground

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that some of the cards do not present registrable matter.

Under section 5 of the bill above mentioned, the registration of this class of objects is provided for as follows:

"Section 5. That every pack of playing cards printed and manufactured in the United States shall be entered under the copyright law in the office of the Librarian of Congress, under the same conditions and provisions of law as those relating to books; one of the cards in each pack of playing cards so copyrighted to bear the notice prescribed by section 4962 of the Revised Statutes as amended."

There is every reason why this measure should become a law, for it will clear the air in regard to this class of registration, and will afford protection, not only for new designs for the faces of ordinary playing cards, but will cover such classes of cards as are designed to be used for the purpose of educating children in the use of words, or in history, geography, the languages or familiar quotations.

PTOMAINE POISONING.

Within the last few days a number of persons in New York City have died from ptomaine poisoning, so that public attention is now directed toward the mysterious nature of these poisons, which are not generally well understood. "Ptomaine" is a generic name for alkaloid bodies formed from animal and vegetable tissues during putrefaction and the similar bodies produced by pathogenic bacteria; it comes from Greek words meaning a "corpse that has fallen." Very often, perhaps generally, the degeneration in the food product is not far enough advanced to offend either the taste or the sense of smell; consequently, suspicion is not excited, and a person eats or drinks something which contains enough of the poison to make a great deal of trouble, if the result is not fatal. We often hear, in the summer, for instance, that persons who attended a picnic were stricken with a violent illness, and that the physicians in the neighborhood were kept busy for hours. The fact is developed that only those who ate ice cream were made sick. Sometimes it is reported that some one had poisoned the food maliciously, but it is known that the cause of most, if not all, of these distressing experiences was the presence of ptomaines in the milk out of which the ice cream was made.

It is not an easy task to trace the history of milk back far enough to reveal the precise conditions under which the ptomaines were developed, but it is believed that failure to properly cool the milk immediately after it was taken from the cows is a partial explanation of the evil. Warm weather favors this condition. The ptomaines of ice cream (tyrotoxicon) are particularly to be dreaded, as well as the other poisons, such as mytilotoxin, found in mussels.

It is not pleasant to contemplate that the air we breathe, and the water we drink, and a large proportion of our food abounds in bacteria of different kinds. Most of them are, fortunately, harmless, or should be if proper precautions are taken. Milk is far from being the only medium for the transference of this poison to human beings. A great variety of solid foods of animal origin are also likely to develop ptomaines. One frequently hears of poisoning by canned goods, such as potted meats or canned salmon, for instance. In some cases a metallic agent, perhaps the solder, is the cause of the trouble, but in the majority of cases the sickness, especially if it is of an intestinal and painful character, is due to ptomaines. To all appearances, the food may be entirely fit for consumption, and perhaps none of those employed in the canning house may be responsible, but the chances are that unperceived putrefaction has set in and that ptomaines have been produced.

Fresh fish and oysters are not exempt from the tendency to develop ptomaines. Indeed, fish was one of the first sources from which these poisons were obtained by chemists. The earliest feat of this kind was performed with gelatine in 1882. Since this time Brieger and others have found a variety of ptomaines, such as cadaverine, putrescin, peptotoxin, muscarin and mydaleine.

Several cases which have occurred in New York City have resulted from eating shad roe, and though it is probable that the tragic death of the great musical conductor Anton Seidl was not caused by this poison, as was at first thought, still this delectable delicacy has been tabooed by many people, owing to the fear which they have of being poisoned by it. The symptoms of ptomaine are vomiting, nausea, diarrhoea and retarded respiration, and in advanced stages coma.

There is no known antidote for this poison, though of course emetics and purgatives should be used where the poison is suspected. There are numerous ptomaines in the body, but they are absorbed by the oxygen or expelled by the bowels, liver and lungs. If not, they strike the nerve centers and sickness results. The real cause of many mysterious deaths is ptomaine poisoning, but there are, of course, many cases of it which do not result seriously.

THE NAVIES OF THE WORLD.

The World Almanac for 1898 contains some most usable tables, showing the comparative strength of the various navies of the world, and we are indebted to this publication for the annexed tables. They were prepared by Lieut. W. R. Hamilton, Fifth Artillery, United States Army, and have been corrected from the latest official reports on file at the War Department, December, 1897.

NAVIES OF EUROPE AND THE UNITED STATES.

CLASS OF VESSELS.	Great Britain.	France.	Germany.	Italy.	Austria-Hungary	Russia.	Spain.	Denmark.	Netherlands.	Turkey.	Portugal	Sweden and Norway.	United States.*
Battleships, 1st Class	29	15	6	8	.....	14	1	.....	.....	1	.....	.....	9
Guns of Same... H. G.	114	57	36	38	.....	124	17	.....	.....	10	.....	.....	136
Guns of Same... S. B.	1,257	615	164	315	.....	332	18	.....	.....	10	.....	.....	297
Battleships, 2d&3d Cl'ss	24	9	10	2	10	4	2	.....	3	8	1	.....	2
Guns of Same... H. G.	254	76	93	27	80	41	29	.....	20	75	3	.....	18
Guns of Same... S. B.	575	216	163	112	204	79	22	.....	37	105	6	.....	27
Sea-Going Coast Def'nce	6	12	8	7	3	7	.....	26	7	6	2	8	6
Guns of Same... H. G.	24	22	24	32	12	20	.....	78	32	40	6	28	30
Guns of Same... S. B.	83	202	116	58	66	84	.....	21	91	63	45	120	54
Non-Sea-Going C't D'ce	11	12	11	....	4	21	2	.....	17	3	.....	18	14
Guns of Same... H. G.	38	18	11	....	4	33	3	.....	15	6	.....	26	24
Guns of Same... S. B.	91	86	22	.....	12	156	6	.....	100	8	.....	45	6
Armored Cruisers	18	13	7	8	2	14	8	.....	.....	.....	.....	.....	2
Guns of Same... H. G.	184	78	14	30	10	137	14	.....	.....	....	.....	.....	38
Guns of Same... S. B.	679	259	256	313	100	287	194	.....	.....	.....	.....	.....	36
Protected and Partially Protected Cruisers	123	47	13	23	8	3	12	5	10	6	4	2	16
Guns of Same... H. G.	535	46	54	52	12	26	98	34	86	44	.....	2	169
Guns of Same... S. B.	2,373	1,085	231	495	40	53	161	48	160	32	48	20	232
Unprotected Cruisers	3	14	6	.....	2	20	4	1	2	2	3	4	5
Guns of Same... H. G.	38	160	48	.....	21	59	20	8	10	29	22	24	18
Guns of Same... S. B.	34	189	45	.....	2	234	25	6	4	16	6	24	16
Gunboats, 1st Class	42	16	2	.....	.....	12	11	9	36	.....	.....	21	19
Guns of Same... H. G.	79	18	2	.....	.....	16	11	9	34	.....	.....	31	107
Guns of Same... S. B.	38	49	.....	.....	.....	52	6	46	84	.....	.....	49	123
Gunboats, 2d & 3d Class	20	33	1	2	8	2	13	.....	15	12	2	....	.....
Torpedo-Boat Dest'yers	103	17	18	18	11	39	17	.....	6	6	3	6	3
Torpedo Boats, 1st Class	51	46	104	117	36	88	11	6	20	12	12	.....	18
" " 2d Class	33	149	54	4	5	6	28	5	12	20	9	37	1
" " 3d Class	107	54	16	70	35	97	9	13	31	4	27	20	2
Hulks and Stationary Vessels	139	86	12	3	9	2	6	6	16	3	....	7	29
Subsidized Vessels	38	12	10	16	....	36	14	.....	.....	54	....	.....	4
Obsolete Vessels	32	30	5	7	5	3	59	2	23	12	23	37	11
Despatch, Training, Transports, Repair, Tugs, and Miscellaneous Vessels	219	105	47	55	21	98	25	61	24	86	44	38	68
Officers	2,243	2,220	967	795	617	1,260	1,009	146	540	392	367	176	†982
Seamen	58,916	49,300	17,820	20,406	11,900	36,000	16,300	1,109	8,320	20,600	4,096	6,780	†12,600
Marines—Officers	746	1,640	236	83	76	382	400	40	43	84	18	123	.....
" Soldiers	17,843	27,800	2,500	440	720	2,890	6,920	264	1,700	1,200	608	1,300	.....
Total Active List	79,947	80,920	21,513	21,734	13,313	40,633	24,629	1,559	10,603	22,276	5,089	8,279	13,582
Naval Reserves	83,000	84,350	37,000	19,600	2,000	45,000	25,000	4,000	10,000	36,000	4,000	12,500	2,800

* This column is inserted for purposes of comparison. † Includes marine corps.
H. G. Heavy guns or primary battery. S. B. Secondary batteries or light guns.

In the table given above, the enumeration of vessels of the United States Navy includes those built and building.

NAVIES OF MEXICO, SOUTH AMERICA AND ASIA.

CLASS OF VESSEL.		Japan.	China.	Siam.	Korea.	Argentine Republic.	Brazil.	Chile.	Ecuador.	Peru.	Uruguay.	Paraguay.	Mexico.
Battleships, 1st class	H. G.	5	20	..	..	..	..	..	..	..	..	..	..
	S. B.		186										
Battleships, 2d and 3d classes	H. G.	2	12	..	..	1	8	2	18	2	11	..	..
	S. B.		17				14		27		44		
Coast defence vessels	H. G.	6	6	..	..	4	12	10	21	1	2	..	..
	S. B.		28				33		51		9		
Armored cruisers		4	..	..	..	1	..	2	..	..	..	..	..
Uuarmored cruisers		22	17	1	..	4	9	3	..	1	..	..	..
Gunboats, 1st class		3	16	..	..	5	14	2	..	..	..	..	..
Gunboats, 2d and 3d classes		6	..	1	2	2	13	8	..	..	..	..	..
Torpedo boats, 1st class		5	4	..	..	18	15	1	..	..	..	..	5
Torpedo boats, 2d class		63	6	..	..	14	7	..	..	..	..	..	..
Torpedo boats, 3d class		79	36	..	..	..	11	12	..	..	..	..	..
Subsidized vessels		3	....	..	..	..	14	15	..	..	..	..	..
Hulks and stationary vessels		3	..	1	..	1	..	3	1	1	1	..	..
Obsolete vessels		7	6	6	..	1	..	2	1	1	3	1	5
All other vessels		9	28	10	..	17	31	15	1	9	7	2	6

H. G. Heavy guns. S. B. Secondary battery.

JUBILEE ANNIVERSARY OF THE AMERICAN SCIENCE ASSOCIATION.

BY HORACE C. HOVEY.

Fifty years ago the American Association for the Advancement of Science was organized for the purpose of promoting intercourse between scientific men throughout the continent, encouraging systematic scientific research and increasing the facilities for more thorough investigation and enlarging the usefulness of scientific labors. These ends have been sought by periodical and migratory meetings, by publications, by wide correspondence, and perhaps, most happily of all means, by encouraging genial and familiar intercourse between scientists.

The completion of the first half century of this noble work will be celebrated in an appropriate manner in the city of Boston, August 22–27, 1898, and the preliminary announcements for the jubilee are already made. The meeting will be held in response to the invitation of the Governor of Massachusetts, the Mayor of Boston, and the numerous scientific and educational institutions that cluster about that center of intellectual life and activity This cordial invitation was accepted at the Detroit meeting of the Association. The Boston Local Committee, now organized, includes a most distinguished list of names, among which we note those of his Excellency Governor Wolcott, as the Honorary President; twenty-five presidents of universities, colleges and other institutions, together with others of distinction, as Honorary Vice-Presidents; one hundred and twenty-nine Members at Large; Dr. Thomas Dwight, Prof. Alpheus Hyatt and Prof. E. C. Pickering, as Honorary Secretaries, and Col. H. L. Higginson as Honorary Treasurer. The latter gentleman is also the Chairman of a strong Committee on Finance. The Chairman of the Reception Committee is Dr. J. R. Chadwick, that of the Committee on Invitations is Dr. Henry P. Bowditch, that of the Committee on Excursions is Gen. F. H. Appleton and that of the Executive Committee is Prof. W. T. Sedgewick. The Local Secretary, to whom all correspondence should be addressed, is Prof. H. W Tyler, of the Massachusetts Institute of Technology, Boston, Mass.

The Boston scientific Jubilee promises to be one of the most important and interesting assemblies of the kind ever convened. Many foreign scientists of eminence will take part in the exercises and make addresses. Foreign educational and scientific bodies will send delegates, thus giving the occasion an international character. A number of "affiliated societies," really the offspring of the A. A. A. S., will meet during the Association Week, including those for the study of Geology, Chemistry, Botany, Forestry, Entomology, Mathematics, Engineering, etc. All general and sectional meetings will be held in the halls and rooms of the Institute of Technology and of the Boston Society of Natural History. One day will be spent as the guests of Harvard University, one day in the historic city of Salem, and excursions are planned for the White Mountains, Cape Cod, and other regions of interest.

Members who have allowed their membership to lapse are requested to renew their connection with the Association. A thousand new members are called for, and every scientific man in America is appealed to in order to make this Fiftieth Anniversary of a great Association a marked event in the intellectual history of our continent. Anniversary cards will be sent, previous to the meeting, to all entitled to them, and a list of members in good standing will be printed for the opening day. Each of the nine Sections will prepare a programme in advance, and notice of papers offered should be sent at an early date to the proper secretary. A special invitation is given to all surviving Founders of the Association, that is, of those who shared in the meeting of 1848. The names and addresses of such should be sent at once to Prof. F. W. Putnam, Harvard University, Cambridge, Mass., so that they may enjoy the recognition to which they are entitled.

FLOORS FOR MAGAZINES.—Cement floors in powder magazines are dangerous, because cracks and cavities may form in them, constituting receptacles for inflammable matter, besides which cement nearly always contains silicious particles which may cause ignition by shock or merely by rubbing. Such floors have been forbidden in France since 1881 and in Belgium since 1894, the mine regulations requiring that powder magazines be floored with asphalt or planks. A circular from the Belgian minister of industry calls the attention of mine inspectors to the necessity, when authorizing a powder magazine, of requiring that the regulations be strictly observed in this respect, and also that timber floors be made of oak planks well jointed, perfectly smooth and free from cracks.

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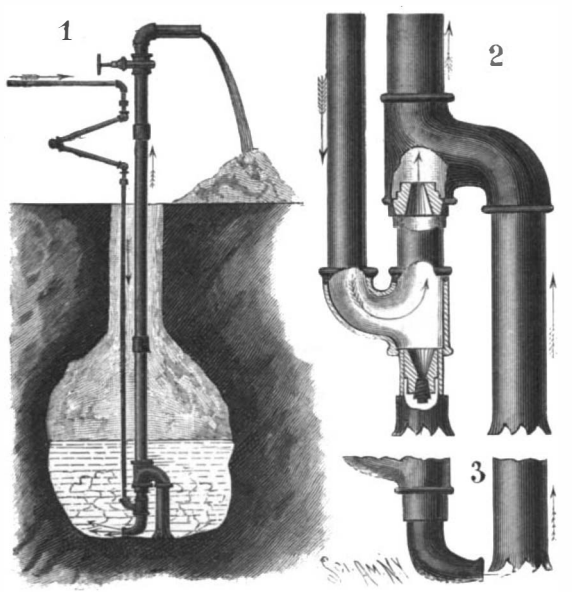
A DREDGE EJECTOR.

The illustration represents an apparatus for use in certain kinds of dredging, placer mining, etc., for loosening sand, mud and gravel, and discharging the loosened material at any desired place. It has been patented by John E. Melcher, of Wisner, Neb. Fig. 1 shows the apparatus in operative position, Fig. 2 being a sectional view and Fig. 3 representing a modified form of arrangement at the bottom of the force pump pipe and the inlet of the discharge pipe. An inlet pipe, as shown in Figs. 1 and 2, is connected at its



MELCHER'S DREDGE EJECTOR.

upper end by a hose or by variously coupled iron pipes with a force pump and at its lower end with a nozzle casing, whereby water under pressure may be discharged upwardly into a casing at the lower end of a discharge pipe, the latter casing having a valve and a downwardly leading extension connected with a suction pipe. At the lower end of the first casing is a short pipe, normally closed by a plug, and adapted to discharge water into a cutter at its lower end, there being a similar cutter on the lower end of the suction pipe. When it is desired to bring extra pressure to loosen some of the ground, the gate valve near the top of the discharge pipe is closed and the plug valve is removed, when the water under pressure passes out around the cutters at the bottom of both pipes, the opening of the gate valve again causing a suction to draw up the loosened material, it being understood that the lower valve has a considerably smaller opening than the upper one, whereby the bulk of the water will be taken up through the upper valve, just below the connection with the suction pipe. The connection of the force pump with the supply or inlet pipe is so made by flexible hose or jointed couplings that the pipe may be moved sidewise or up or down as desired, so that the apparatus may be moved in all directions from the pump, and the supply pipe may be swung as required around the suction pipe, the whole turning on the nozzle casing. As shown in Fig. 3, a short pipe or nipple at the lower end of the inlet pipe casing has its mouth in alignment with the cutters at the lower end of the suction pipe.

A LOCOMOTIVE AND ITS EQUIVALENT IN RAW MATERIALS.

We have received from Mr. F. W. Webb, the locomotive superintendent of the London and Northwestern Railway, England, an extremely interesting photograph which is herewith reproduced. It shows a freight locomotive—one of a very successful class of eight-coupled machines designed by Mr. Webb some years ago for handling the coal traffic—and gathered in front of it, each in a separate pile by itself, are the various raw materials which would be consumed in the manufacture of one of these engines.

The piles of material show graphically the relative bulk of the materials, and the subjoined table gives their weight in pounds:

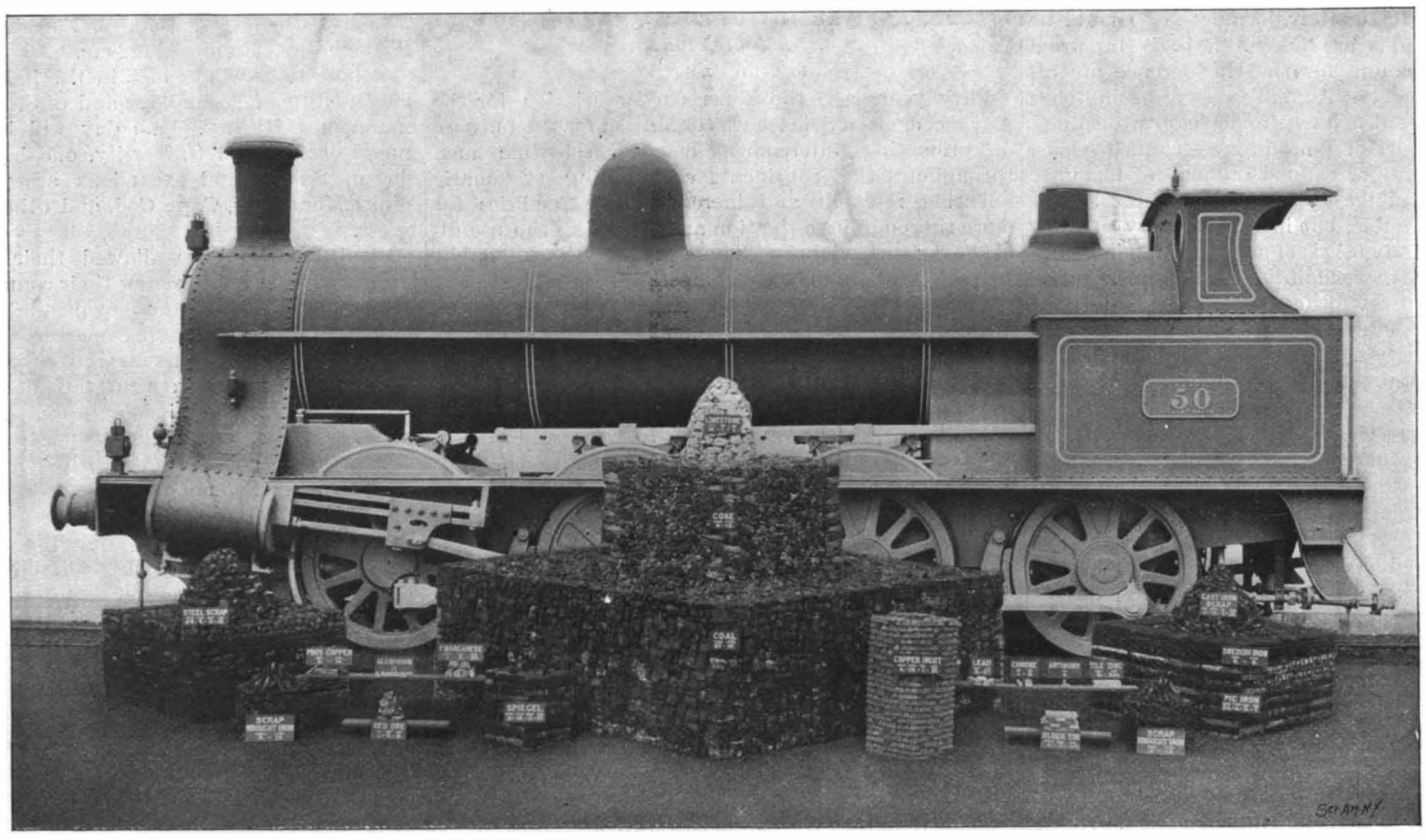
	Pounds.
Coal	128,800
Steel scrap	63.043
Pig iron	54,215
Wrought iron scrap	16,352
Swedish iron	14,448
Copper ingot	11,137
Coke	10,304
Spiegel	6,373
Cast iron scrap	3,403
Limestone	2,045
Block tin	546
Ferro-manganese	132
Red ore	120
Lead	83
Tile zinc	76½
Phosphorus copper	70
Chrome	30
Aluminum	13
Antimony	4
Total	311,194½

The total weight of the raw materials, then, is about 155½ tons. The finished engine weighs only about one-third as much, so that about 100 tons of material are either consumed or disappear as waste in the various processes of manufacture.

The exhibit is, we believe, quite unique, and is eminently instructive. It may not be known to our readers that the London and Northwestern Railway Company has long been considered as one of the chief, if not the chief representative railroad of Great Britain. Its works at Crewe are entirely self-contained, practically everything required for the various branches of the railroad equipment being manufactured by the company in one vast establishment; so that it is probable Mr. Webb would not have to send outside of the works for any of the material represented in our engraving.

The small size of the cylinders relatively to the locomotive is accounted for by the fact that the latter is a compound, with two outside high pressure cylinders and one inside low pressure. The outside cylinders, 15 inches in diameter, are connected to the second pair of drivers, and the 30-inch low pressure cylinder is located beneath the smoke box and between the frames, and drives the third pair of wheels by means of a crank turned in the center of the axle. The drive wheels are 51 inches in diameter and the stroke of both high and low pressure cylinders is 24 inches.

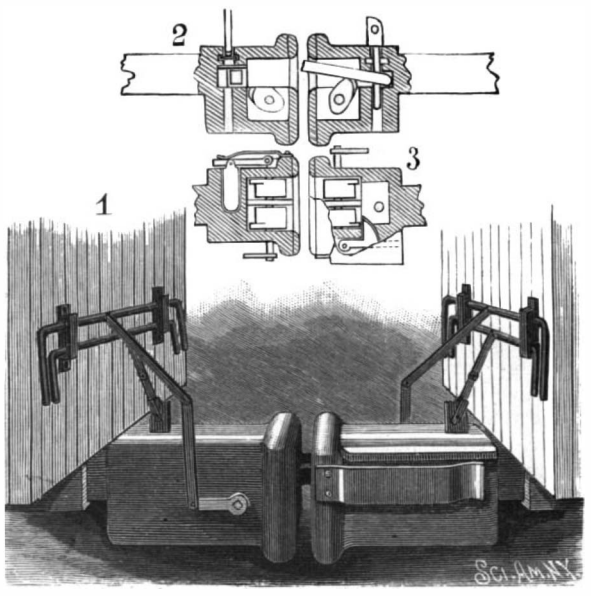
A compound express engine of this type was shown at the World's Fair, Chicago. Mr. Webb has built a great variety of compound locomotives on his system during the past twenty years, and they have invariably shown very economical results. A four-cylinder compound is one of the latest developments in the Crewe shops, and, as it is to be tested against an identical locomotive as respects weight, size, etc., of the simple type, the results will be awaited with much interest by the locomotive world.



A FINISHED LOCOMOTIVE AND ITS EQUIVALENT IN RAW MATERIALS.

AN IMPROVED CAR COUPLING.

In the car coupler shown in the illustration the ordinary pins and links are used, but they are operated by means of rock shafts on the ends of the cars, obviating the necessity of trainmen passing between the cars.



DUTCHBURN'S CAR COUPLING.

The invention has been patented by Christopher Dutchburn, of Highfield, Ontario, Canada.

Fig. 1 represents the device in use, Figs. 2 and 3 being sectional views. Extending transversely through each coupling head is a shaft on which are two lifting cams located in cavities adjacent to the drawhead throats, the cams serving to lift the links, as indicated in Fig. 2. The pins slide vertically through passages in the rear of the coupling heads, a horizontally sliding plate crossing each such passage to hold up the pin, and the plate being pivoted to a wing hinged to one side of the coupling head and pressed against by a leaf spring. Each wing has a lug projecting through an orifice into the drawhead throat, so that an entering link, as the cars meet, engages the lug, by which the plate is withdrawn and the pin drops into engagement with the link. At each end of the car are two rock shafts having at their ends crank arms, an intermediate portion of each shaft also having a crank arm, the crank arm of one shaft being adapted by link connection to raise the pin, while that of the other shaft operates a crank on the shaft carrying the cams by which the link is lifted. By these means both the links and the pins may be readily manipulated without requiring the trainmen to pass between the cars.

THE Société des Laboratoires Bourbouze, of Paris, offers scientific courses to workingmen, free of charge, on Sunday, from nine to eleven o'clock. Physics and chemistry will be taught in the laboratories, the courses being adjusted to the practical needs of the students.

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THE NEW STEEL ARCH AT NIAGARA.

The work of erecting the steel of the new all-metal arch which is to take the place of the upper suspension bridge at Niagara Falls has commenced and is being carried on with such vigor as to convince one that, for all the river is very wide at this point, it will not be long before the two great arms of the arch, now building out from each side simultaneously, will meet and be joined over midstream. The bridge that the arch is to replace is the last of the great suspension bridges across the Niagara chasm at the Falls. It was built in 1889 under the supervision of G. M. Harrington, to fill the gap between the cliffs caused by the wrecking of a former bridge by a hurricane on the night of January 9-10, 1889. The first bridge on this site was of wood and iron. To prepare for its building, connection was made between the cliffs by carrying a rope across from bank to bank on an ice bridge. By means of this rope cables were strung, and the first bridge on the site was opened to the public January 2, 1869. The roadway, being but 10 feet wide, was not large enough to allow carriages to pass on it, and so long waits at either end were occasioned in crossing. The towers of the original bridge were also of wood, consisting of 12 by 12-inch pine timbers, 16 of which were grouped together under the saddle plate to support the main cables. In building the old bridge the arrangement of the members of the towers was so planned as to admit of the widening of the suspended structure from a single track 10 feet in width to a double track 17 feet wide, to permit of the passage of vehicles in opposite directions. This work of enlargement was commenced in the fall of 1887 and consisted of sinking shafts for new and increased anchorages to support the two additional cables required to support the increased weight of the superstructure and the additional floor surface of the widened bridge. After the 2¼-inch steel ropes, seven of which formed each cable, were placed in position and the suspenders for supporting the trusses had been attached, the trusses were sent out from the ends in 30-foot sections until they met in the center and were connected, after which the work of removing the old wooden structure and inserting the new floor system was begun. On the night of June 12, 1888, the last part of the old wooden bridge was removed, and on December 15, 1888, the new steel suspension bridge was pronounced as completed. It was considered a memorable occasion. The bridge companies had every reason to believe the new structure would last longer than they would live to control it. In this they were in error. On the night of January 9-10, 1889, before the bridge was a month old, it was swept away by a fierce hurricane from the southwest. Within a few hours of the calamity, however, contracts had been let for the material for another bridge, and the work of reconstruction was rushed night and day. Material was on the ground in seventy days, and on March 22, 1889, the work of rebuilding the bridge was commenced. On May 7, 1889, traffic across the gorge was resumed, and the structure was hurried to completion. Once more the bridge companies viewed their work with extreme satisfaction. The new structure was given additional strength, and it was the common belief that it would last for ages.

Not so, however. The elements of nature had wrecked one structure, and other factors were to bring about the removal of the later structure. Chief among these was the element of progress. When the suspension bridge was completed, the Niagara locality had not yet felt the developing influence of the electric road system. This experience it was yet to have. The trolley made its entrance. It laid hand on and captured beautiful routes along the Niagara gorge on both sides of the wild and attractive river. Then came the thought that a connection between the electric roads on the New York State side with those on the Canadian side, together with a crossing between Lewiston, N. Y., and Queenston, Ont., would form a belt line destined to win wide popularity. Such a scheme, however, necessitated the construction of a stronger bridge across the gorge; for the new suspension bridge had been designed with the idea of running heavy trolley cars across it. These are the incidents that led up to the building of the new steel arch, which, when completed, will be the greatest structure of the kind in the world.

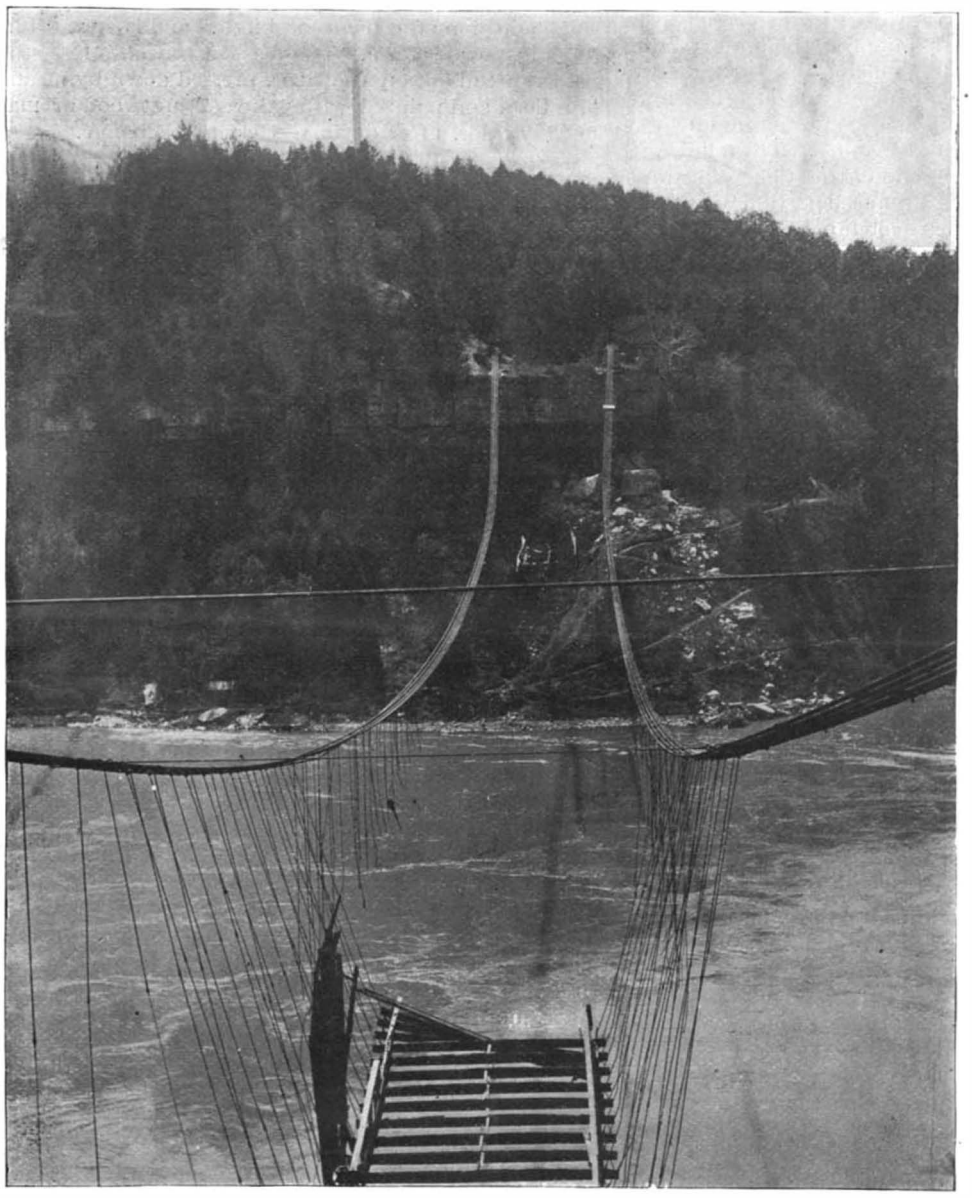
At the point where the bridge crosses, the cliffs are 1,268 feet apart. The abutments are located close to the water's edge and the clear span will be 868 feet long. It will be by far the longest steel arch in the world, as will be evident from the following comparison:

Name of Bridge.	Span.	Rise.
Niagara, U. S. A.	868 ft.	150 ft.
Louis I., Oporto, Portugal	566 "	146 "
Garabit, France	543 "	170 "
Grand Trunk, Niagara	550 "	114 "
Pia Maria, Portugal	525 "	121 "
Eads St. Louis Bridge	520 "	47 "
Washington Bridge, New York	510 "	91·7 "
Paderno, Italy	492 "	123 "
Rochester Driving Park	423 "	67 "

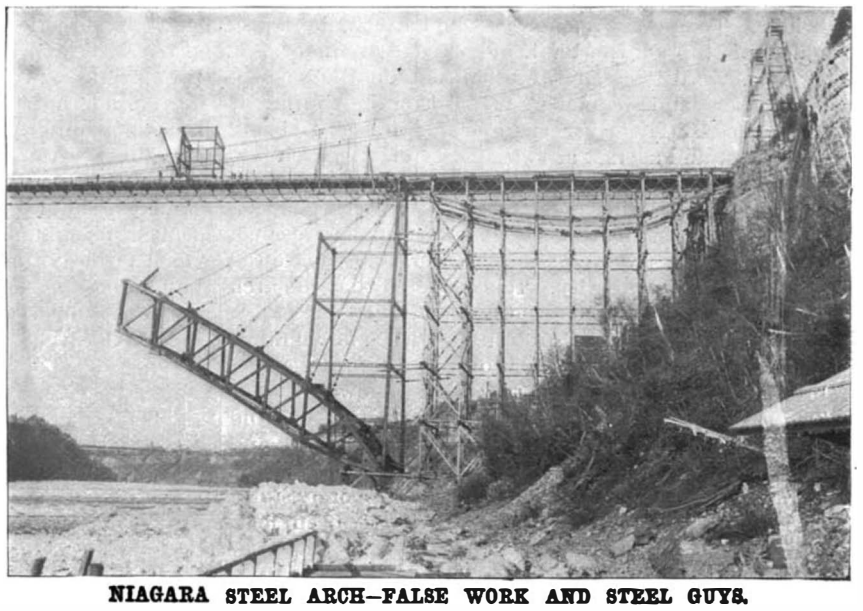
The main span will be connected to the cliffs by two shore spans, one of which will be 210 feet long, the other 190 feet. The arch will be a single deck structure. Its width will be about 49 feet, and this will be divided longitudinally into three parts. In the center, about 23 feet will be given up to double tracks for an electric road service, and on either side of the tracks there will be carriageways about 8 feet wide, while beyond these, elevated a few inches above the roadway, will be walks for pedestrians. The rise of the bridge will be about 150 feet from the level of the piers at the skewbacks to the ribs at the crown of the arch. The depth of the trusses is about 26 feet. The floor of the arch will be about 192 feet from the surface of the water in the river. The arch was designed by L. L. Buck, and he is the chief engineer of the work. The contract for building the bridge is in the hands of the Pencoyd Iron Works, of Philadelphia.

It is evident that to rebuild such a bridge as the suspension bridge across the Niagara with a bridge of different pattern, on the very same site, and without interfering with travel over it, calls for considerable skill and ingenuity. Skilled labor only can be employed, for an inexperienced workman may not only lose his own life, but he may do that which might bring death or injury to others, especially in such a dangerous work as that at Niagara, where to drop from the work means almost certain death.

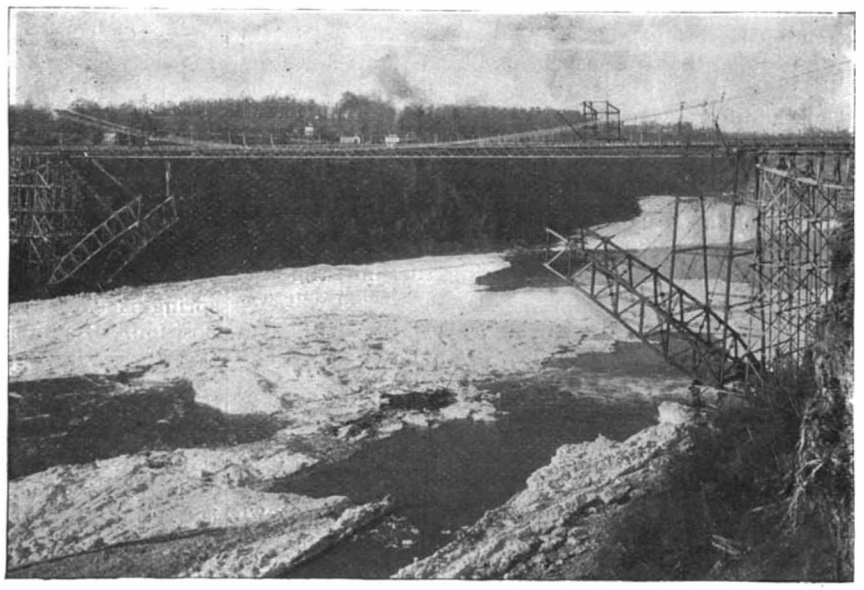
The decision to build this arch was made some years ago. The abutments were built in the fall of 1895, and have ever since awaited the erection of the steel upon them. The abutments are four in number, two on each side of the river, standing about 67 feet apart. They are located close to the edge of the water in the lower river. The method of their construction was as follows: The accumulated dirt and loose rock on the debris slopes of the river bank at the points of operation were removed until solid rock was reached, hydraulic means being used in this excavation. The rock was cut away in step form and on this a concrete foundation was built. The concrete used was made of Portland cement mortar and broken stone that would pass through a two-inch ring. The stone used was flint rock, the engineer in charge objecting to the use of sandstone or limestone, owing to the pressure the abutments would have to sustain. One measure of cement was mixed dry with 2½ measures of clean, sharp Canadian sand, and then water added to make a moderately thick paste. Broken stone was spread over the mortar in proportions of about 4½ measures to 1 to insure filling all voids with mortar. This was thoroughly mixed and deposited in layers of 10 to 12 inches and rammed sufficiently to flush the interstices with mortar. Into the concrete portion of each abutment four 3-inch wrought iron anchor bolts or rods 21½ feet long were built, each extending 10 feet beyond the concrete surface. In addition to the four rods sunk in



WRECK OF THE OLD LEWISTON SUSPENSION BRIDGE.



NIAGARA STEEL ARCH—FALSE WORK AND STEEL GUYS.



ERECTING THE STEEL ARCH WITH THE AID OF THE PRESENT SUSPENSION BRIDGE.

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the concrete, four other rods of the same material and size pass through the stone work of the abutments, making in all eight anchor bolts in each abutment, the end of each one extending beyond the coping stones about one foot to afford an anchorage for the iron anchor plate or shoe. The total weight of the 32 rods in the abutments is 9,910 pounds, while the 32 washers countersunk in the concrete weigh 3,536 pounds, the latter being of cast iron free from flaws. The abutments are magnificent samples of ashlar masonry, the stones used weighing from two to six tons apiece. Three of the stones used for the copings of the abutments on the New York State side weigh six tons apiece and measure 7 feet 6 inches wide by 2 feet thick. The stone was obtained from the Chaumont, Jefferson County, quarries, and it was found necessary to drill 4-inch holes through over half of them in order to lower them over the anchor bolts. It was found necessary to employ derricks of unusual strength in lowering the stones over the bank. They were dropped 60 feet to a skidway, and then lowered about 190 feet along the skidway to the work.

Preparatory to the erection of steel, the Pencoyd Bridge Works erected great structures of timber false work between the abutments and the banks. This false work extends from the bank up to the floor of the bridge. Temporary anchor pits had already been provided on top of the bank at each end of the bridge. The top chord of the arch was run out on the suspension bridge, and the placing of steel on the abutments commenced. The river span or main arch is being built first, and as fast as two chords of the arch are placed, anchor cables are run down to sustain the weight. Movable derricks, erected on the suspension bridge, aid in letting the iron down to the point needed. Since the shoes were placed the work has progressed with surprising rapidity. It is expected that the arch will be completed during the summer.

The present suspension bridge will be taken down and rebuilt on the site of the old Lewiston suspension bridge, seven miles down the river, below the falls. There it will take the place of the picturesque old wreck, which, since April 16, 1864, has swung back and forth in the breeze, telling the story of man's carelessness to properly guy it before the coming of a storm which swept its floor away. The guys had been loosened during an ice jam, fearing that when the ice went out it would carry the guys with it, and, fair weather following, the men in charge forgot the necessity of reanchoring the guys. When a storm swept down the gorge, the bridge fell easy prey to its violence. It is understood that the suspension bridge, in its new location, will have a trolley track on its floor to allow trolley cars to cross the river at that point, thus forming a part of the proposed belt line about the gorge.

Incidentally it may be remarked that plate No. 2 shows three bridges—the suspension bridge, the new steel arch in construction, and one of Niagara's famous ice bridges, reaching from shore to shore. The form of the ice bridge changed during the short time the pictures were being taken. This was because it was preparing to go out, or pass down the river, which it did within an hour after the views were taken.

The Typewriter Barred Out.

A rule of the House of Commons is that all petitions must be laid before that body in written or lithographic form, but recently the Hon. Mr. Gedge submitted a memorial from his constituents of the town of Walsall in typewritten manuscript and created quite a sensation, says The Chicago Record. The Speaker declined to receive it, on the ground that it was a violation of the rule and an infringement on the dignity of the House. He contended that typewriting was neither manuscript nor lithography, although he admitted that the rule was adopted before the invention of typewriters. Mr. Gedge gave notice that he would take the earliest opportunity of moving an amendment to the rule, in order that a modern invention which is of great convenience and a decided improvement over pen and ink manuscript might be recognized.

The same rule applies to all of the official departments of the British government. All documents that emanate from the various branches of the Ministry are still written in long hand upon the same kind of paper that has been in use for several centuries and is manufactured expressly for them. No private individual is allowed to use official paper for any purpose whatever. And quill pens are still the ordinary instruments of literary labor in the executive departments as they are in the universities, the courts and in the old-fashioned lawyers' offices. We visited an examination room in one of the colleges at Oxford the other day where a lot of students had just finished the examination known as the "Greatgo," which comes at the end of the college year, and upon the table in the center was a large box filled with several hundred quill pens which had just been discarded by the students and were being gathered up by the janitors. It was only recently that steel pens were allowed in the Bank of England.

A typewritten communication on official subjects would not be received in some of the British offices nor in the courts, but we in America are almost as far behind the times, for it is only since the Harrison administration that typewriters have been used in the State Department at Washington. Even now all communications to the foreign legations of the United States and the diplomatic representatives of other governments at Washington have to be written in long hand. Our ministers abroad are still required to use the same method in preparing their dispatches to the government. Mr. Blaine was the first man to introduce the typewriter, and if he had remained in office several years longer, that convenient instrument would have been furnished to all of the foreign representatives of the United States.

AN AUTOMATICALLY CLOSING UMBRELLA.

The illustration represents an umbrella of comparatively simple construction, which may be conveniently opened, but is designed to close automatically on simply pressing a knob or button. The improvement has been patented by Charles E. O. Hager, of North Baltimore, Ohio. The small figure is a sectional view of a portion of the handle and the ribs folded down. In the outer end of the hollow stick slides a rod carrying near its outer end a crown on which are fulcrumed the ribs supporting the cover, and each of the ribs is connected by a sectional brace with a runner rigidly connected by a pin with the sliding rod, the pin extending through slots in the outer end of the stick and the crown and the runner moving in unison. The brace has a short outer pivoted section, and the middle of its main inner section is pivotally connected by a link with a crown rigid on the outer end of the stick. The inner end of the sliding rod has a reduced portion on which is a coiled spring, and its extreme inner end has a knob which projects through an aperture in the stick near the handle, the knob engaging the aperture when the umbrella is open, and holding the several parts locked in open position. When the umbrella is closed, the

HAGER'S UMBRELLA.

spring is extended to hold the several parts in closed position. By having the short section in each brace, the ribs readily open when the rod is pressed inward, as the short section can readily give until it opens out into a straight line with the other section.

The First Railroad to the Arctic Sea.

The first railroad running to a port on the Arctic Sea is the continuation of the Vologda Railway, in Russia, which is now finished to the port of Archangel, on the southeastern corner of the White Sea and at the mouth of the river Dvina. This new line, which was opened some weeks ago, says The Engineering and Mining Journal, is nearly 400 miles in length. The Vologda-Archangel Railway passes for the most part through deserted or sparsely populated regions, or across "tundras" and marshes, which are sometimes 50 feet in depth. The whole nature of the country through which the new line passes was unfavorable to its construction. Marshes and patches of bog and swamp had to be filled in; the newly made embankments were continually giving way and had again to be built up until the necessary stability had been obtained. Six iron bridges and numerous bridges of wood were required. The wooden bridges are built upon piles driven, in some cases, to a great depth beneath the surface. The new line is of military as well as commercial importance, for it must play a leading part in the opening of the northern provinces of Russia. It will furnish an outlet, for instance, for the deposits of petroleum which exist in northern Russia, but have not been worked on account of the lack of transportation.

A NEW antiseptic of much value as a bactericide has been manufactured at Elberfeld from a formula given by Dr. Eichengrün, chemist at the factory of Bayer & Company. The preparation is called protargol, and is a compound of silver and protein. According to Dr. Benario, of Frankfort, a one per cent solution destroys the bacteria of anthrax and enteric fever. The preparation is also employed as a powder and as an ointment.

Miscellaneous Notes and Receipts.

Paper Hanging by Machine.—Paper hanging by machine is the latest achievement, says the Werkstatt. The arrangement used for this purpose is provided with a rod upon which the roll of paper is placed. A paste receptacle with a brushing arrangement is attached in such a manner that the paste is applied automatically on the back of the paper. The end of the wall paper is fixed at the bottom of the wall, and the implement rises on the wall and only needs to be set by one workman. While the wall paper unrolls, and, provided with paste, is held against the wall, an elastic roller follows on the outside which presses it firmly to the wall. When the wall paper has reached the top, the workman pulls a cord, whereby it is cut off from the remainder on the roll.

Paper floors are enjoying a steadily increasing popularity, which is readily explained by the many advantages they possess over wooden flooring. An important advantage consists in the absence of joints, whereby accumulations of dust, vermin and fungi dangerous to health are done away with. The new paper floors are bad conductors of heat and sound, and, in spite of their hardness, have a linoleumlike, soft feel to the foot. The costs are considerably lower than those of floors made of hard wood. The paper mass receives a small addition of cement as binder, and is shipped in bags, in powder form. The mass is stirred into a stiff paste, spread out on the floor, pressed down by means of rollers, and painted with oakwood, nutwood or mahogany color, after drying.—German exchange.

Fugitive Colors of Gems.—A remarkable fact is reported by the Journal für Goldschmiedekunst, viz., that the colors of precious stones are not permanent in the light. To give a chemical and physical explanation for this is difficult; for, although chemical reactions in solid bodies have been proved, one would not presume them to occur in the exceedingly hard minerals concerned. A ruby which had been left for two years in a light show window was found to be considerably lighter after this time had elapsed than a stone, previously of exactly the same color, which had been kept in the dark. Similar results were observed with emeralds and sapphires. Still more hasty than with these valuable colored gems is the action of light on the less expensive stones. Garnet and topaz differ in that the former becomes dim and dull, while the latter only turns lighter.

The Lakes of Cerium as Compared with Those of Iron and Tin.—Since the rare earths are now worked up in industry, cerium salts are obtained as a by-product, for which no use has been found so far. The author investigated whether and in what manner they might be employed as mordants in wool dyeing. He found that sheep's wool, on boiling with tartar and cerium sulphate, fixes the latter completely and firmly, but that the dyeings obtained on it do not possess any practical advantages over the other known methods. For the dyeing experiments the author used a tight cloth of sheep's wool which was heated about an hour with 4 per cent of cerium sulphate and 3 per cent of tartar, close to boiling, whereby the liquor was almost entirely exhausted. In a similar manner he dyed on tin lakes (mordanting with 4 per cent of tin salt and 2 per cent of oxalic acid) and iron lakes (12 per cent of green vitriol and 12 per cent of tartar, etc.) with logwood, alizarine, cochineal, Avignon berries, alizarine orange, sanders, and alizarine yellow. From the results compiled in a table it appears that, as regards resistance to acids, the tin lakes change their shades least (with the exception of the alizarine lake and alizarine orange lake), only becoming, as a rule, considerably lighter. As regards the acid-resisting properties of the cerium lakes, cochineal, Avignon berries and alizarine yellow are entirely fugitive, the original color almost returning. Alizarine, alizarine orange, and logwood changed their color entirely, the lake with logwood being so little acid-resisting that even the small quantity of tartaric acid remaining from the mordanting sufficed to prevent the formation of the lake in dyeing. It was necessary, therefore, to add a small quantity of ammonia for the neutralization of this tartaric acid, in order to attain the formation of the lake. The most acid-resisting is the cerium lake of sanders, while the iron lakes were found to be the least fast to acids. As regards the original color of the different lakes, it was found that the lakes of cerium are doubtless more approaching the iron lakes than the tin lakes, which is all the more to be observed as wool mordanted with cerium is in itself absolutely uncolored, while material mordanted with iron is known to be very strongly colored. As a general rule, the tin lakes are very bright and brilliant, while the cerium lakes and the iron lakes are dark; on an average the former have a redder tinge, the latter more of a blue one. In virtue of the similarity of cerium to the iron oxides and the sesquioxides respectively, and the dissimilarity of the lakes to those of tin and the monoxides respectively, one might regard as an established fact the assertion of modern chemistry that cerium is a sesquioxide.—Gustav Matschak in Mittheilungen k. k. Gewerbe Museum; Chemiker Zeitung.

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THE SANDY HOOK MORTAR BATTERIES.

(Continued from first page.)

service, and more are under construction. The fortification of this important point possesses more than usual interest at the present time, when defensive preparations of all kinds are being pushed forward with haste. The original plans called for 176 mortars for New York, located at various points.

Our engraving shows a quarter of what is known as Battery No. 1 A, and it is situated on the Sandy Hook spit, so that it controls not only the entire ranges of channels leading into the lower bay, but the lower bay as well. The mortars are hidden behind and below great earthworks, so that only a shot dropping in vertically could injure them. A shot of this nature could hardly be fired from a war vessel, owing to the great elevation of the guns which would be necessary. In 1895 the stringent regulations regarding fortifications were relaxed sufficiently to allow members of the press to inspect the fortifications; but since our visit they have been closed against visitors, so that it is possible some changes have been made, but we believe the facts gathered by our representative at this time are accurate as regards the mortar batteries at present.

In the first place, the mortar battery is on a part of the Hook where it cannot well be seen except from one of the lighthouses or the other fortifications. The arrangement of the battery will be understood by reference to our plan. It consists of an earthwork with four pits, with flaring sides connected by underground bombproof passages. It is surrounded by a solid counterscarp wall twenty feet high. This wall is not intended in any way as a protection from the enemy's fire, but merely as a shield against a storming party's assault on the works. Inside of this wall and immediately at its base is a deep ditch. The space between the wall and the embankment would prove an awful place of slaughter for invaders, as at two corners of the wall are rapid-fire guns commanding all four of the trenches, and a murderous fire, which nothing could resist, could be poured out on the assailants.

From the ditch rise great earth embankments sloping gradually to a height of 35 feet. The four mortar pits are protected by a wall of concrete of great thickness and a lining of steel. The pits themselves are small, being just large enough for the four big mortars, which are set on turntables which can be moved by one man. We have already described the 12-inch mortars used for this fortification. (See the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 888, 920.) Mortars of this kind can be built in less time than rifles and at a less cost, and when supplemented, as at Sandy Hook, with forts equipped with the most modern coast defense guns, they are very effectual, as the war vessels cannot stay long enough at great range, which is necessary to give the guns sufficient elevation, to do the mortar batteries damage. Ordinary shell firing from rifled guns gives greater range or greater penetration at the same range; but, on the other hand, the sides of armored ships, at the water line at least, are protected by thick armor, while the decks are not very heavily plated; so that a shell or armor-piercing projectile would inflict serious injury on a vessel, even though she had a thick protective deck, for the shots would pass through a 6-inch steel deck. The greater accuracy, also, of horizontal shell firing is in part offset by the system of firing mortars in groups, so that if some shots may go a little short of the vessel or beyond it, there will remain others which will fall directly upon it. The full service charge for the 12-inch mortars is 80 pounds of brown prismatic powder and a shell weighing 1,000 pounds carrying 100 pounds of high explosive. An extreme range, with satisfactory accuracy, of five miles has been attained. Tests of these mortars have demonstrated that the fire can be so concentrated that the projectiles fired from a group of sixteen mortars, fired simultaneously, if desired, will fall well within the space covered by a ship's deck plan, crushing the mightiest vessel afloat like an eggshell with the tons of projectiles, not to mention the explosion of the high explosives. Our engraving shows only one pit of the mortar battery, there being four in all, but the mortars may be fired individually, in groups of four or the whole sixteen may be discharged at once. Each mortar is moved independently, and the men at the mortars can see nothing but their guns, the armored embankment and a little patch of blue sky overhead. They do not fire the mortars nor do they see the vessels in the channel. All the officers and men have to do is to train their pieces according to the directions telegraphed to them by the observers, who may be half a mile away.

The observers have range and position finders and glasses, while spread out before them is a map or chart of the harbor, marked with numbers inclosed in squares. If a hostile warship approaches, they "plot" her course on the chart until it is decided that she is within effective range. The observers find that the war vessel is going in a certain direction and at what speed. From this they calculate that she will be in a certain square at a certain time. Then they telegraph the order and designate the location of the ship to the man who does the firing. The latter is located at that point marked X in the plan. He can see nothing down in the bombproof gallery except a chart, a duplicate of the one used by the observers. The officer in the mortar battery has a table showing at what elevation his mortars will fire a shot to carry such a distance. He quickly makes his calculations and sends his orders to the pits. Up go the shining muzzles, until they point to the sky, then there is a pause and suddenly the dull brown mound of earth on the sand spit, not visible from the doomed vessel, spouts flame like a volcano and one or four, or even sixteen projectiles, each weighing half a ton, rise and descend in a graceful curve on the warship.

The magazine bisects the central bombproof gallery and it is protected in all directions by earth and steel. Running from the magazines to the mortar pits and from mortar to mortar are steel tracks for the little cars that serve the guns with ammunition. Turntables are placed at the intersection of the galleries, and the entrances to the pits and bulletproof doors are hung at the main entrance and each of the counterscarp galleries.

The huge battery, with its two 12-inch breech-loading rifles on gun lifts with a maximum range of ten miles, was completed at about the same time as the mortar batteries, and in an emergency like the present

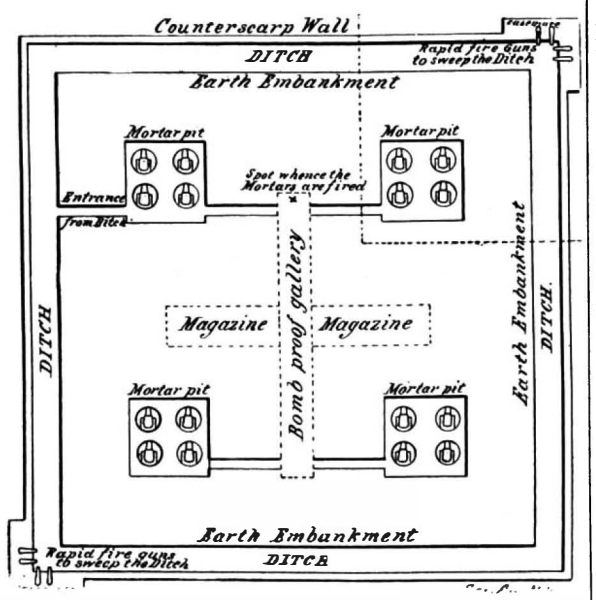

DIAGRAM OF MORTAR BATTERY No. 1A SANDY HOOK N. J.

it is gratifying to know that the most important harbor of the United States is so adequately protected against invasion by sea.

The Current Supplement.

The current SUPPLEMENT, No. 1163, contains several articles of unusual interest. An article on the "Maxim Gun" describes the very latest forms of this important machine gun. Various forms of guns are illustrated, including the tricycle, naval and the extra light rifle for cavalry and infantry use. "The Passy Railway Tunnel" describes the work on the underground railroad which will put the center, the west and the periphery of Paris in rapid communication for the coming exposition. "The Cinematograph" is an important article detailing the actual construction of the camera, the printing slide, the safety lantern, etc., with directions for developing, washing and fixing the films. This is an article which our readers have desired for a long time. "Experiments with the Glow Lamp" is an article by Hiram Maxim. "Dr. Meyer's Expedition to the Source of the Xingu" describes life in the forests of Central Brazil. "The Debt of the World to Pure Science" is the presidential address at the annual meeting of New York Academy of Sciences, by Prof. J. J. Stevenson. "Poison and Poisoners" is an interesting and popular article. "An Interesting Case of Gastrotomy" describes the removal from the stomach of twenty-five staples for barbed fence wire, fifteen screws, six horseshoes, forty-six wire nails, twenty-one cartridges, two pocket knives, bolts and pieces of chain, making 119 pieces in all. "The Red and Blue Coloring Matter of Flowers" is an interesting botanical article.

ACCORDING to a report of the Paris Journal des Arts, the director of the Rheims Museum has submitted to the French Academy of Sciences a number of small glass mirrors which have lately been found in Gallo-Romanic tombs of the Marne department. They are of the size of watch crystals, slightly convex and covered with pure lead without any admixture; they had been fixed in boxes as ornaments. In olden times the metallic mirrors are known to have been employed not only for looking glasses, but also as ornaments on tables and other furniture, even on dishes. Gradually other metals, such as tin, copper, silver and antimony, were added to the lead in producing the glass mirrors. In the thirteenth century pouring the lead over the glass was commenced, which signifies the first step toward the manufacture of the famous Venetian mirrors.

Science Notes.

Twenty-two business men, who acted as the coroner's jury in the investigation of the recent great fire in London, and served for fourteen working days, received four pence (eight cents) each as compensation.

C. B. Davenport points out the important part played by water in the growth of plants, and compares the developmental processes which go on in the tip of a twig to those which occur in the animal embryo. In both there is first a period of rapid cell division with slow growth; next a grand period of growth in which the general form of the embryo is acquired, the rudiments of the organs are established, and the organism increases rapidly in size by the imbibition of water; while finally there is a period in which the histological differentiation is carried on, while the absolute growth increments cease to increase.—Proc. Boston Sc. Nat. Hist., 1897, p. 73.

While the population of Europe, estimated at 175,000,000 in the beginning of the century, rose to 216,000,000 in 1830, 300,000,000 in 1870, and is now nearly 370,000,000, there has been a still more remarkable increase in the number of towns with over 100,000 inhabitants. There were only 21 of these in 1801 (with 4,500,000 inhabitants), 42 in 1850, 70 in 1870 (with 20,000,000 inhabitants), and 121 in 1896 (with about 37,000,000 inhabitants). In 1801 France had three towns with over 100,000 inhabitants, while England and Germany had two each, but in 1870 the figures were—England 18, Germany 10, and France 9, while in 1896 they stood—England 30, Germany 28 and France 10.

At the last convention of the American Medical Association, in Philadelphia, Dr. J. B. Learned, of Northampton, Mass., described to the fraternity his simple method for the cure of insomnia, or sleeplessness, the whole thing being accomplished without the usual resort to drugs. Briefly, muscular and mental exertion, in a systematic way, is the course involved; that is, a series of positions of the body, lying upon the back and side in the horizontal line, with the brain occupied in controlling and making changes, is the substance of the treatment proposed, the brain being occupied in devising these changes and modifying the respirations—this calls blood and vital energy away from the center of matter that keeps up the automatic motion and prevents sleep. The doctor terms this "turning off the belts." The muscular motion consists in fixing a certain group of muscles for a definite length of time, and then another and another change; fatigue soon comes to muscle and brain thus controlled, and sleep is inevitable.

Some particulars of interesting observations made with steam turbines are given in a paper read before the Albany Institute by Mr. J. F. McElroy, says Engineering Mechanics. He states that a disk varnished with shellac will throw the whole of the varnish off when run at a very high speed. The lac under these conditions flows over the surface of the wheel toward the periphery, where it is flung off, about one hour being required for the complete stripping of the surfaces. A particular turbine wheel, he states, caused little trouble up to a speed of 3,500 revolutions per minute, but on attempting to increase its speed beyond this figure, vibration was set up and the flexible shaft on which it was mounted sprung sideways ¼ inch to ½ inch. Raising its speed still further, a state of stability was again reached at which the wheel ran quietly, but on approaching a speed of 7,000 revolutions per minute vibration again appeared. The trouble arising at the critical speeds was, he found, mitigated by a gentle end pressure on the shaft at these periods. With ball bearings he had failed to get satisfactory results, as soft steel was used for the bearings. This steel flowed under the pressure of the balls, even very lightly loaded.

Scientific Ballooning.—In order to test the accuracy of the formula of Laplace for deriving the altitude of a balloon, etc., from the barometric record, Cailletet has devised a photographic camera which has been constructed by Gaumont. A prismatic box is suspended from the balloon, says The Engineer. Lenses are inserted in the lower and in the upper face. Between the two a band of sensitized celluloid is moved by a clockwork and exposed at regular intervals. The one lens produces an image of the scenery down below on the earth, the other of the needle of the barometer, whose point appears near the center of the plate, which has a size of 13 by 18 centimeters (5 inches by 7 inches). From the distance on the plate between two prominent objects on the ground the height of the balloon can be derived. Satisfactory experiments having been made with this apparatus on the Eiffel Tower, Hermite and Besançon took it up with them on October 21 in their new balloon of 1,700 cubic meters capacity, a gift of the Russian scientist Balaschof. The weather was tempestuous, and the balloon descended after a trip of four hours, having attained an altitude of 2,500 meters. The camera is said to have answered very well; twenty-six photographs were obtained. The apparatus is now to be secured against the influences of very low temperatures.

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THE KEY OF THE GULF—THE TORTUGAS ISLANDS.

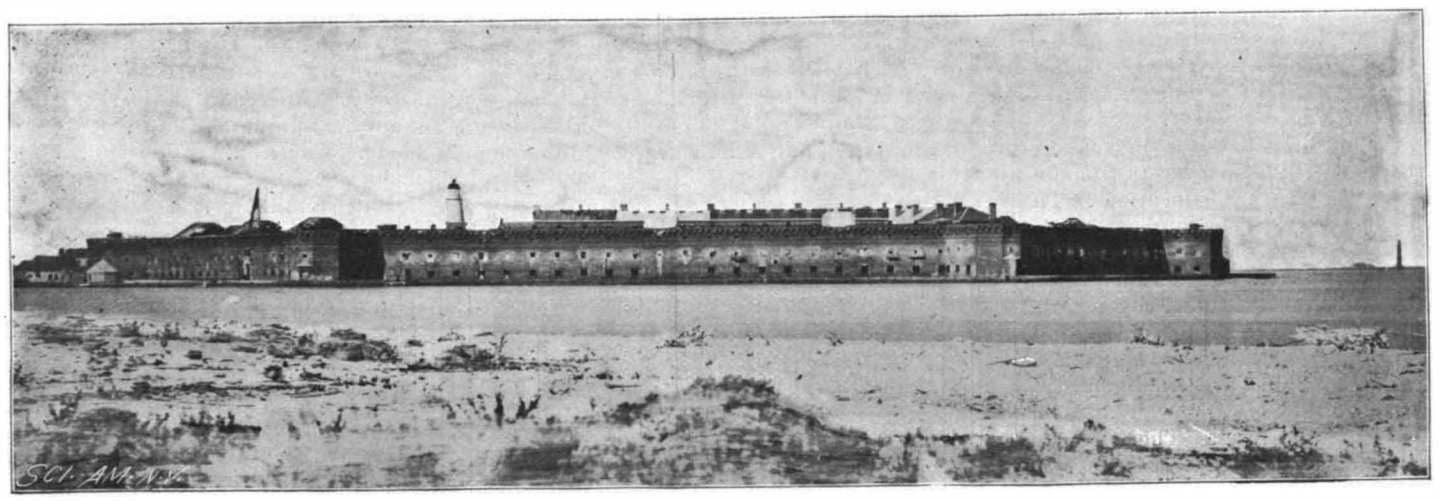
BY C. F. HOLDER.

Dry Tortugas is an erroneous term applied to the group of keys or islands which constitute the extreme outer Florida reef. Key West is the most important as regards inhabitants, now boasting a large Cuban or Spanish-American contingent. Continuing to the southwest, we come to the Marquesas Islands, and finally, about sixty miles from Key West, lies Garden Key, on which is situated the finest fort of the old class in the United States; a magnificent structure, three tiers of brick masonry, filled in with concrete—the whole forming a defense which, while of not much service to-day against modern guns, was, during the late war, considered a formidable fort.

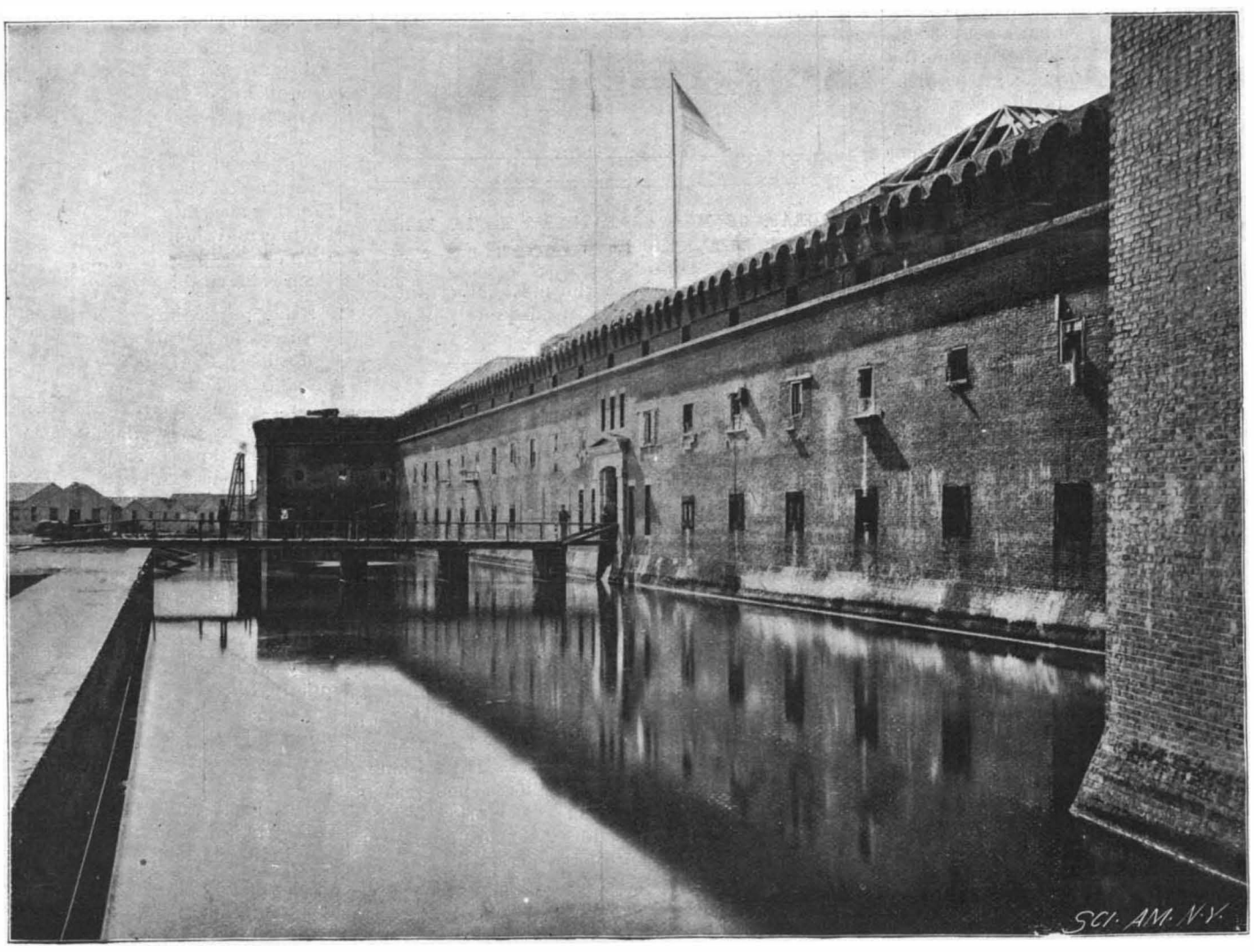
The Tortugas Islands have been almost neglected since the war, when the Dry Tortugas obtained a somewhat unenviable reputation by being used as a military prison. Tortugas was not so disagreeable a place as it was painted.

For thirty years it has been almost deserted. The old guns are lying where they were left by the troops, some unmounted, the carriages rusting in the sun and rain, and the fort has an appearance not creditable to the government that has expended millions upon it. But now indications point to the belief that the old fort will be rehabilitated, and the garrison, which has been commanded by some of the best known officers in the army, will again assume an air of life and activity.

For some time it has been in the hands of the Department of State, which established a quarantine station here, and army surgeons have been studying the yellow fever germ theory. But the threatened trouble with Cuba has resulted in the re-establishment of the post as an army and naval station. The White Squadron is lying off the fort; coal has been sent there for the fleet, and a large contract has been given for the deepening of the harbor near Garden Key, so that the largest cruisers can run in and coal.



THE FORT AT DRY TORTUGAS.



MOAT SURROUNDING THE FORT AT DRY TORTUGAS.

It is a singular commentary on the inactivity of the government for the past three decades that this post or fort, the most important strategetical position in the South, the key of the Gulf, the Gibraltar of America, should have been left in charge of a sergeant all these years and practically ignored. In 1819, the United States purchased these keys and the whole of Florida for the sum of $5,000,000; and considering the fact that the keys are but a few hours' run from Cuba, it was deemed necessary to fortify the exposed points; so Fort Jefferson was begun in 1847, and Fort Taylor, at Key West, some time later.

The laboring work was done almost entirely by slaves hired from their masters in Key West, the skilled mechanics coming from the North. In 1859 and 1860 Fort Jefferson was near completion, but war being declared, it was hurriedly fortified, and has never been entirely completed nor has the original plan been carried out, which would have made it one of the strongest fortifications in the world.

Approaching the group from the east, the keys gradually take shape—East, Middle, Sand, North, Loggerhead, Bird, Garden, Long and Bush Keys. East Key is the largest; Loggerhead the longest and bearing the light of that name. They are all made up of coral sand and shell, washed up by the sea, and capped by a thicket of bay cedars, and in some instances mangroves. The entire group, roughly speaking, including the outlying reef, occupies an area of seventy square miles; being about ten miles in length from north to south and perhaps five or six from the Bush Key reef to the outer reef west of Loggerhead. It is really an atoll, cut by a maze of deep blue channels which wind in and out in a marvelous manner, forming an ideal and perfect harbor, but so narrow that it would be difficult for the largest cruiser to turn. During the war the largest transports entered the port; even the large ship "Vanderbilt," afterward changed into the sailing ship "Three Brothers," entered the harbor, which is very deep.

The main entrance is from the east, vessels sailing for Loggerhead Light, three miles away, almost passing Tortugas, then a buoy is suddenly seen, and the vessel nearly doubles on her tracks and steams into a narrow, intensely blue channel, which completely encircles the key, so that a vessel passing in the main channel is not obliged to turn, but passes directly around the key and out again.

Fort Jefferson stands in the center of the group, and the original plan was to have the various islands, Bird, Sand, East and Loggerhead Keys, provided with batteries. This can now be done, and with sand-bag forts, and one or two disappearing guns of the largest caliber on each key surrounding the fort, the place could be made impregnable.

The old fort presents a picturesque appearance, and seems to rise directly from the water. The key contains thirteen acres, and the fort almost surrounds it, there being about an acre of ground on the outside; but on the north, west and south fronts the sea wall breasts the sea, and between it and the fort there is a wide moat ten or twelve feet deep at high water, beyond which rise the walls with their frowning ports. Each face is pierced for one hundred and thirty large guns; and as there are five faces, the total equipment would be about five hundred guns. The two lower tiers are in casemates; the third on the parapet, where at each angle there is a bastion tower, reached from below by a winding granite stairway, all of which gives the old fort an attractive and castellated appearance. The writer well recalls standing here at the outbreak of the war, watching an incoming steamer which was supposed to be the Alabama or some Confederate cruiser. There was not a gun on the fort at that time, and as the vessel refused to stop at the command of the health officer, those on the fort, of whom the late Quartermaster-General Meigs was one, supposed that they were to be captured. The vessel proved, however, to be a transport loaded with guns and troops, and from then on Fort Jefferson was well equipped. It was here that the conspirators were sent, and some of their efforts at escape made life at the fort extremely exciting at the time.

From the water the great fort presents a frowning front, but, landing at the wharf and passing over the drawbridge into the interior, one understands fully why the term Garden Key was given to this island. Here are groups of lofty cocoanut palms on either side of the walls, while beneath a grove of mangrove trees is the path lined with out-of-date shell and solid shot which have stood here for nearly forty years.

The quarters for officers and men are perhaps among the finest in the country, and are large three-storied buildings following the general direction of the faces. The one on the north and west is the officers' quarters, while that to the east is for the men. It was here that Billy Wilson's men mutinied during the war. An old-fashioned lighthouse rises a few feet above the parapet, and at its base is the keeper's cottage, where for years lived old Capt. Benner, who, it was said, found twenty thousand dollars in doubloons at the wreck of an old galleon on East Key, eight or ten miles away. This house and light are made the location of "Jack Tier," one of Cooper's novels.

The ground of the interior is white sand, here and there covered with Bermuda grass and a long wiry grass which grows like a vine, throwing out roots here and there and forming a trap to the unwary. The

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parade ground is in the center, and here the writer saw many battalions of prisoners mustered during the war. They were sent down in transports, and as they marched ashore were a sorry lot. Many were manacled or secured with ball and chain, being considered desperate characters, and sentenced to Dry Tortugas for a term of years

Prior to the establishment of Fort Jefferson, in 1847, the islands were the resort of wreckers and pirates, who reaped a rich harvest from the wrecks of the time. The writer discovered a large Spanish gun, with the coat of arms of Spain still intact, on the shoal reaching out from Bush Key. The gun was raised and placed in the fort.

More important than Tortugas is Key West, where a city has sprung up, and property valued at millions of dollars is almost entirely unprotected. The island of Key West is about five miles in length and one in breadth. The city, or rather the most prosperous portion of it, is on the southwest side, where the reef reaches away and affords protection to a fine harbor—one which would float the navies of the world, and is of great importance as a naval station. The island rises to a maximum height of twelve feet, this being a calcareous ridge. At other places it is but a few feet above the water. Yet the accumulation of soil is sufficient to afford luxuriant vegetation, the island being covered with trees, bananas, plantains, guavas, cocoanuts, tamarinds, and other tropical fruits being prominent.

The armament of Key West is of the ancient type, and entirely obsolete. It consists of a fine fort of the old style. Fort Taylor rises directly from the water on the southwest side, commanding the approach to the harbor. It is connected with the land by a drawbridge, having a fine front of granite and brick, with castellated walls, bastions, etc. Like Fort Jefferson, Fort Taylor is pierced for three tiers of guns. The accessory defenses consist of two martello towers. These have casemated walls, but are useless from a modern standpoint.

The question of climate is one which interests many when this region is to be repopulated with troops. The writer spent several years at Tortugas, and is prepared to say that, when the quarantine rules are absolutely lived up to, it is as healthful a place as one could wish.

The great reef which surrounds the Florida keys in former years was interesting as being the only coral reef on the American continent within the jurisdiction of the United States. At Tortugas it represents an area of seventy-five or one hundred square miles, and was a vast grove of coral polyps, cut here and there by the deep blue channels peculiar to the region; but some peculiar occurrence has changed much of this. A few years ago the coral of the reef, even so far as Key West, died, and at present it is difficult to find any in shoal water, where formerly it could be taken up by the cartload. It is assumed that an earthquake opened a crack in the vicinity, permitting sulphurous fumes or some gas to escape that destroyed the polyps. This is of course theory, but the fact remains that something occurred which resulted in the almost total destruction of coral life in this locality. But this may be only temporary. Corals grow much more rapidly than is generally supposed, and in a short time the reef will again blossom with these mimic flowers.

H. L. RUSSELL and S. M. Babcock consider that profound changes of a physical and chemical nature, which occur in milk from which bacterial fermentations have been excluded, are of a non-vital character and due to the presence of ready formed enzymes in the milk as obtained from the cow. Moreover, they have separated out proteid converting enzymes, and proved that they exert a curdling as well as a digesting function when applied to milk. They believe, therefore, that the ripening of hard cheese is caused by the joint action of bacteria and enzymes.—Nature, lvii., 373.

PUEBLO ARTS AND INDUSTRIES.—II.

BY COSMOS MINDELEFF.

The western tribes of the Pueblos, and especially the Moki Indians of Arizona, have been but little affected by the march of time since the Spanish conquest three and a half centuries ago, and many of their arts and industries are almost exactly the same as they were when described by Castañeda. In the eastern Pueblos, along the Rio Grande, there have been many changes in the life of the people, who have been to a certain extent Mexicanized, and the arts found in an almost aboriginal state in the West, on the Rio Grande are all more or less modified by that influence. The more primitive western tribes have, therefore, received much more attention from scientific investigators, and are naturally of more interest in the present state of our knowledge. When the purely aboriginal features of Pueblo arts have been exploited, the study of modifications due to contact with a higher culture will have an even greater interest.

HOPI MAIDENS, SHOWING PRIMITIVE PUEBLO HAIR DRESSING.

Perhaps the best known art of the Southwestern tribes, aside from pottery making, is blanket weaving. The blanket is an integral part of the Indian dress, and in the manufacture of the highest grade the Mokis have always been pre-eminent. Oddly enough, among these Indians weaving is the work of the men, whereas in other tribes, and especially among the Navahos, who roam over the surrounding country, the weaving is exclusively done by women. Much has been written about Navaho blankets, and within recent years enormous quantities have been shipped out of Arizona and New Mexico by the traders, but the much finer Moki blankets are but little known. Among the Navahos the art has already passed through that stage of degeneration which invariably attacks a native art for the products of which a large foreign demand arises, and it is difficult now to purchase a Navaho blanket more than a year or two old, while the types, both of design and weaving, prevalent five or six years ago are now practically unknown. Such conditions are now just beginning to affect the Moki manufactures, and it is interesting to note that the changes of a year or so past are greater than those of the previous three centuries.

The illustration shows the native costume of the Moki women, as also the style of hair dressing peculiar to them and described in the last paper of this series (SCIENTIFIC AMERICAN, January 15, 1898). The essential part of the dress is a blanket woven in a fine lozenge pattern, of native black wool, bordered with a wide band of dark blue, separated usually from the body of the blanket by a raised cord of green. The two ends are brought together and sewed, except a space of a few inches to allow the passage of the arm, thus forming a baglike garment open at both ends. In use the blanket is draped over the person in the manner shown in the illustration, passing under the left arm and over the right shoulder, the right arm passing through the opening left near the top of the seam. When the wearer is not at work, the blanket is often drawn over the left shoulder, leaving only the right arm free, as shown in the uppermost of the three figures in the illustration.

Sometimes an additional blanket is thrown over the shoulders. Castañeda says: "The women wear blankets, which they tie or knot over the left shoulder, leaving the right arm out." That description, so far as it goes, applies as well to-day as it did in 1540. He adds that "They gather their hair over the two ears, making a frame which looks like an old fashioned headdress."

The blanket dress constitutes practically all of the native woman's costume. On occasions, and especially when she goes away from home, a woman may wear moccasins, made of deer skin with rawhide soles. A large part of the deer skin is left attached to the moccasin, and is wound round and round the lower leg, forming a bulky kind of legging, but this is more often seen among the Navahos, who travel much, than among the Pueblo women, who seldom leave home. It is a common sight, however, along the railway which passes near some of the eastern Pueblos, where the women congregate on the platform at train time, to peddle fruit and pieces of pottery to the passing traveler. There also the native blanket dress can be seen, usually worn over an underdress of calico print. This underdress is rare in the West.

There is a charming simplicity about some of the customs of the western Pueblos, which still retain their aboriginal form. When a young man has determined in his own mind that life without a certain young woman would be but a dreary waste, he speaks to his own parents about the matter and they prepare for him a little bundle of gifts, in which is usually included a blanket and a buckskin. This bundle he takes to the house of the young woman and leaves it there carefully and by stealth, so as not to be seen; but usually a pair of very interested eyes watch his movements from within. If the bundle is returned, he knows that he must seek elsewhere; if it is retained, he thereupon becomes an accepted suitor, and thereafter the young couple can be seen on any bright day in some sheltered nook on the house top, the man knitting himself a pair of woolen leggings or footless stockings and the girl dressing his hair with a bunch of grass or straw, the ends of which serve as comb and brush; for these people are very proud of their long black hair, and devote much time to its care. When all the preliminaries are arranged, the man goes to the house of the woman's people and becomes an adopted member of her family. This custom has had a marked effect on the architecture of the villages, as will be pointed out in a later paper of this series. That the custom is an old one is evidenced by the remark of Castañeda: "When any man wishes to marry, it has to be arranged by those who govern. The man has to spin and weave a blanket and place it before the woman, who covers herself with it and becomes his wife."

Although the Navahos now make only the coarsest and cheapest blankets of native-grown wool, using fine Germantown yarn in their finest work, the Mokis still make their best blankets of yarn spun by themselves. Their best work is the woman's dress blanket,

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and although not so elaborate in design or gaudy in color as the Navaho product, it is technically equal if not superior. There is a tradition that when sheep were first introduced by the Spaniards they were never shorn until death, so that the supply of wool was very limited; but, be that as it may, the Indians now shear their sheep regularly and dispose of most of the product to the traders, for their own needs are but slight.

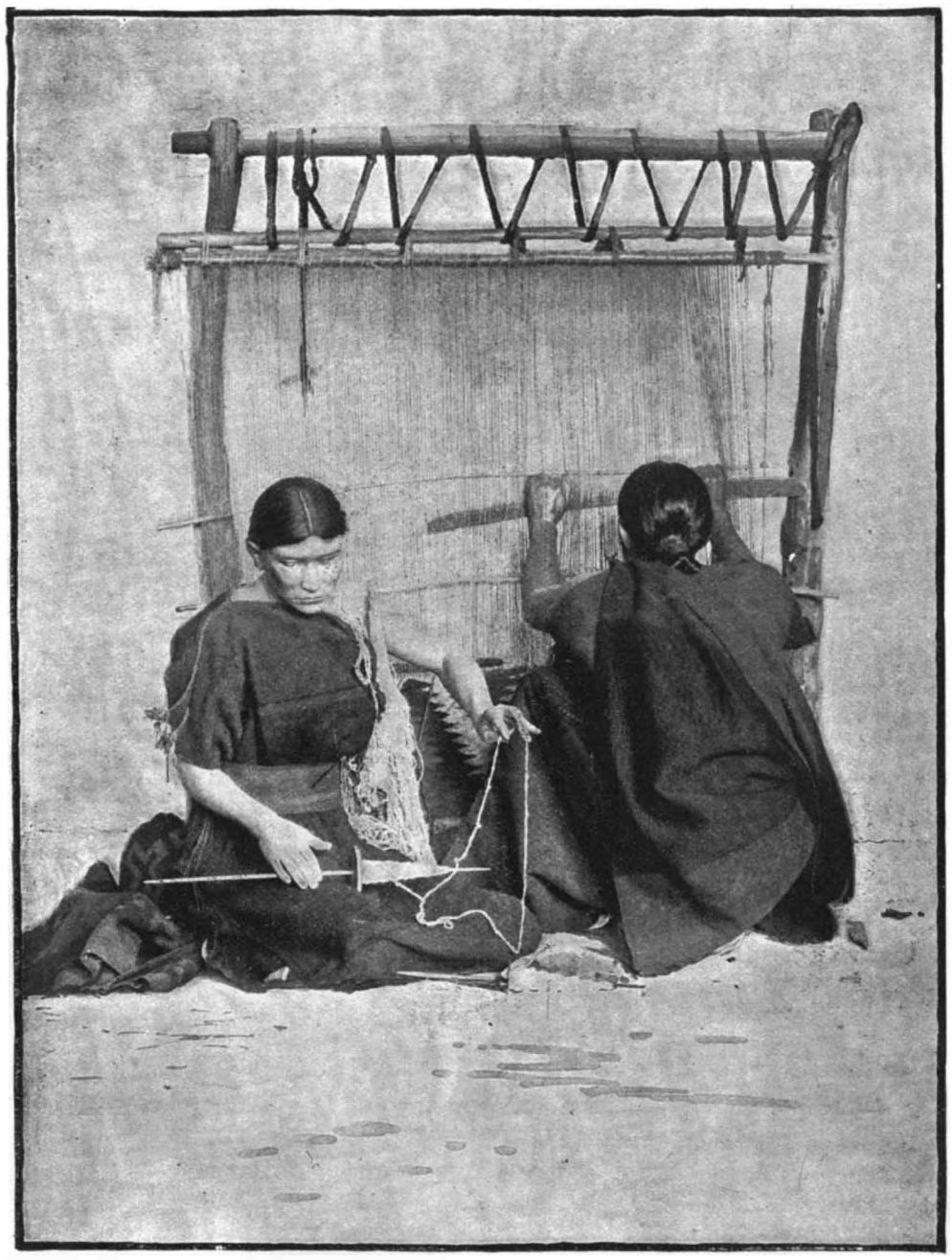
The illustration shows the manner of spinning and weaving, both very primitive, but still effective. After the wool is washed it is carded on metal cards purchased from the traders and made into coarse yarn, with the aid of a spindle consisting of a light stick on which a disk of thin wood is mounted. The stick is rolled on the thigh, and no wheel or any other appliance than the simple spindle is used. Should any dye be used, it is applied always to the finished yarn, but black, white and brown wools are often used without dyeing.

The loom is extremely primitive, as the illustration shows. Among the Navahos it is set up in the open air wherever convenience dictates; among the Mokis it is usually inside the house, although examples are found now and then on the terraces. The finest blankets are woven on looms set up in the sacred underground chambers or kivas, which are not in ceremonial use during the summer months and are at that time used as a club and lounging place by the men of the tribe. Many of the kivas have appliances built into them at the time they were constructed, for the attachment of looms, and were apparently designed as much for use as blanket factories as for ceremonial purposes. The Moki blankets have long been an article of barter with other tribes.

The process of weaving is extremely tedious and slow, and often months elapse between the beginning and the completion of a blanket, but time is not an element considered by an Indian workman. If he can secure $3 for an ordinary saddle blanket, he is content. A bed blanket brings from $6 to $10, while fancy blankets of American yarn have been sold for $50 and $60. The dress blanket of the Mokis can seldom be purchased for less than $10, and they are difficult to procure at any price.

There is a considerable demand for Indian blankets on the part of travelers and men who live more or less in camp, but it is a singular fact that Indians themselves never use them as a body covering when they can procure others of American make. It is no uncommon sight in a trader's store to see an Indian trading three or four native blankets for one of American manufacture. The reason is simple. Owing to the coarseness of the yarn and the crude looms employed, the native blanket is heavy but is not warm. Cold winds penetrate it easily, although one of the types common a few years ago was woven of hard twisted yarn beaten down so firmly that the blanket would hold water for several hours. In a bed, where the blankets are covered by others and protected from direct contact with cold air, they serve fairly well, although heavy in proportion to their warmth. The Indians themselves seldom use beds of any kind, and have little use for warm body coverings, except when in the open air. When a man is at home, his costume consists usually of nothing but a breech cloth, and children of both sexes run naked until they are five or six years old. The body thus becomes inured to changes of temperature, and the ordinary costume of calico shirt and breeches is sufficient.

But the nights are always cool in the plateau country, owing to its great elevation above the sea, and some additional covering is then necessary. The blanket supplies the needs of the people exactly; but the American blanket is so much softer and more flexible, so much lighter in weight, and, withal, so much warmer, that it has practically supplanted the native product for Indian use.



SPINNING AND WEAVING.

TRUFFLES will soon be cultivated on scientific principles and are likely to become cheaper. M. Chatin, who discovered that the truffle is a mushroom, has announced to the Académie des Sciences, at Paris, that the Duc de Lesparre, brother of the Duc de Gramont, has found out how it germinates and on what leaves its spores will become fruitful.

Physiological Effects of Snake Venom.

The effects of snake bite, the physiological influences of snake venom, have been a subject of extreme interest to the schools of medicine and the wider audience of the unprofessional public. Experiments have been made by a series of observers, and the prevalent impressions of those who have witnessed the results of snake bite in the human subject have been recorded and compared. In the Journal and Proceedings of the Royal Society of New South Wales for 1895–96 I have recently come upon a rather comprehensive article on this topic, from which, on account of its new data, I condense a general review of the subject, which must interest the great number who regard this singular pathological phenomenon with natural wonder.

Prof. C. I. Martin, who prepared the paper referred to, has especially experimented with the poison of the Australian black snake (Pseudechis porphyriacus), one of the most deadly and sinister of the group of vipers. Snake poison is rapidly absorbed when introduced in a serous sac "such as the pleural or peritoneal cavity;" its effects most quickly shown when introduced directly into a vein. The interesting question whether snake venom can be absorbed by the mucous membrane of the alimentary canal seems answered in the negative. Weir Mitchell showed that it was not absorbed from the crop of pigeons, though in the case of abrasions of the same it was. Fayrer and Richards thought they proved a slight absorption, which modified Mitchell's conclusions. Martin found two rats in excellent health at the end of a week which "were fed daily for one week on bread and milk containing one hundred times a fatal dose of venom." But abrasion of the stomach resulted in death in two hours and a half. The fæces contained no venom. It was supposedly destroyed in the alimentary tract, as it is decomposed by artificial pancreatic digestion. It is not destroyed by gastric digestion. A third experiment seemed to show a slight absorption.

Venom introduced in the blood kills the leucocytes, changes and decomposes the red cells, dissolves out the hemoglobin and leaves shriveled nuclei. These nuclei "soon began to swell, the granules became less distinguishable and eventually disappeared. The disappearance of the red cells was so complete that at the end of fifteen minutes there was nothing except the slight coloration of the field to distinguish the preparation from one of lymph." Blood corpuscles of different mammals exhibit marked variation in their power of resistance. The dog seems the most sensitive; among lower animals, the frog. In the case of injection the hemoglobin crystallizes even within the body. "The urine nearly always contains such crystals, and on three occasions an animal died two or three days after the injection of the poison with suppression of urine, and microscopic examination of the kidneys has shown the tubules to be completely blocked with hemoglobin crystals." Martin is inclined to believe that the disappearance of the leucocytes is due to their collection in the tissues, not to their rapid destruction. Generally venom induces clot, but this tendency is succeeded by an opposite effect. In one instance "the blood in the whole vascular system, excepting only the pulmonary veins and the left auricle, was found to be solid." Recently fed dogs died from venom in a shorter time than fasting dogs. Rapidity of injection hastens death. Large quantities of venom can be introduced slowly into the circulation without producing clotting. The first portion increases coagulability, this is superseded by an opposite action, "and the establishment of this inhibitory phase confers immunity against the remainder of the injection." The resistance to clotting establishes so-called "negative phase blood," in which the delay to coagulate reaches such a limit that putrefaction first sets in. The toxic bodies known as nucleo-albumens produce identical results with those caused by venom.

In man, after death from poisoning, the blood is almost invariably fluid—a result due to resistance, by which the negative phase superseded coagulation. Venom destroys the germicidal power of serum. Venom breaks down the walls of the blood vessels, causing internal hemorrhages. The power of venoms from different poisonous species varies, in this respect, greatly. Boiling or raising the temperature of venoms very markedly diminishes their toxicity. The venom depresses the circulatory mechanism. After injection the blood pressure is lowered and a profound action upon the circulation effected. Again, blood pressure may subsequently be increased owing to intravascular clotting, by which the arterial blood is prevented from emptying itself into the veins. Martin inclines to the belief that the fall in blood pressure from venom "is mainly due to a direct action of the poison upon the heart," not, as assumed by Mitchell and Reichert, upon the vaso-motor centers. Kidney and spleen contract in volume from snake venom. Snake venom affects the nervous system, causing "depression, faintness, loss of co-ordinating power and ultimately paralysis." Martin describes the effect of venom upon an animal as follows: "It produces uneasiness which varies according to the amount injected, sleepiness, lethargy, and, in a dog, vomiting. The lethargy increases and is succeeded by weakness, which is at first most manifest in the hind quarters. The animal remains quiet and disinclined to move. If made to walk, its gait is unsteady and accompanied by inco-ordination of movement. At the same time it responds less readily to any form of stimulation and its senses appear dulled. Later it is quite unable to stand, the pupils become dilated and insensible to light, and the breathing shallow and slowed." Again, "It would appear as if the poison must reach a certain proportion in the circulating blood before it can seriously interfere with cardiac contractions, but once this proportion is reached, the heart is very speedily and profoundly affected." Respiration at first quickened, in the next stage is diminished and asphyxiation results. Body temperature may be increased or lowered, owing first to a distinct heat-producing (thermogenic) effect and secondly to refrigeration induced by depression and muscular apathy.

In cobra poisoning, convalescence, if the system successfully resists the venom, is abrupt, and no bad effects supervene, not even albuminuria; but in viper poisoning "the animal suffers from great local and widespreading hemorrhage and œdema, which almost invariably suppurates."

L. P. GRATACAP.

PARIS has found it necessary to put a check to the haphazard decoration of her public places. The prefect of the Seine has appointed a technical committee of artists, architects, and other competent judges, to which all plans affecting the outward appearance of the city must be submitted for approval.

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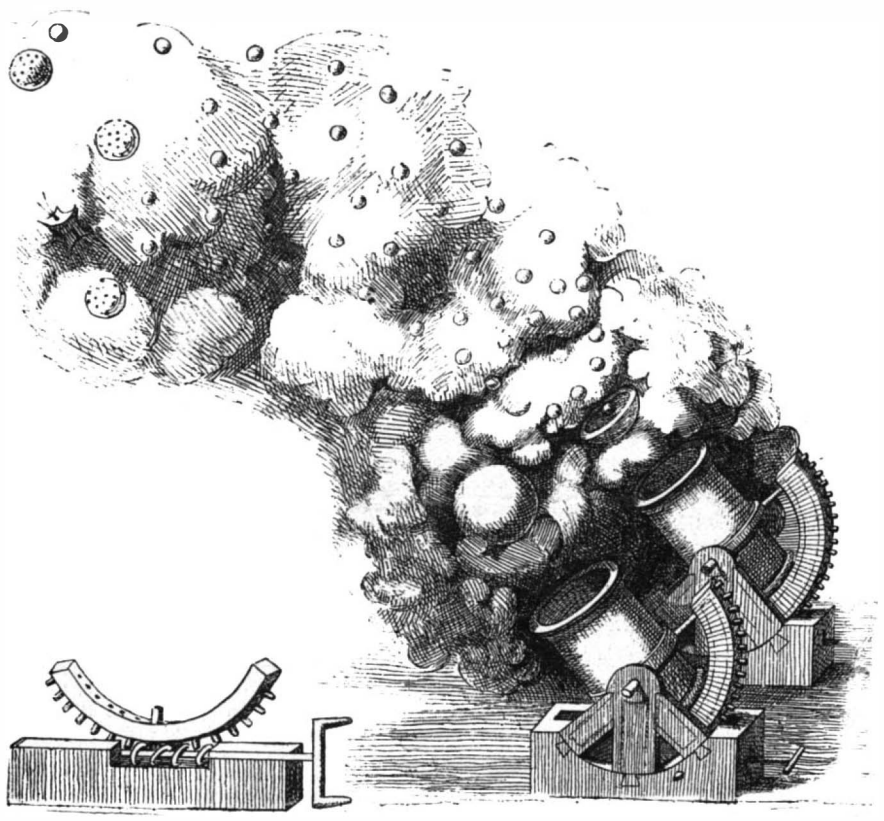
LEONARDO DA VINCI'S HIGH ANGLE MORTAR.

Leonardo da Vinci was one of the greatest and most versatile men who ever lived. When universality of talents are considered, all must stand aside in Leonardo's favor. During his lifetime, 1452–1519, every human attainment was his, and nearly every honorable pursuit, barring the commercial, was followed by him with more or less success. He was painter, sculptor, architect, poet, musician, philosopher, psychologist, author, critic, traveler, aeronaut, mathematician, physicist, chemist, geologist, mineralogist, astronomer, anatomist, physiologist, surveyor, topographer, engineer (civil, mechanical, mining, naval and military), and inventor.

We cannot concern ourselves with any of the achievements of this remarkable man, except to briefly refer to one of his most curious inventions, which is the direct precursor of the modern high angle battery which we illustrate elsewhere.

In his capacity of a naval and military engineer Leonardo showed his love for the terrible. In the memorable letter intended for the Duke of Milan, which is one of the curiosities of the Renaissance, he describes the various engines of war which he could fabricate, and the means by which he could overcome the enemy. Leonardo has left hundreds of sketches of catapults, ballista, gigantic crossbows, breech-loading cannon, mitrailleuses, serpentine organs, and steam cannon. The breech-loading cannon antedated Leonardo, though he made substantial improvements in it. He devised breech-loading mitrailleuses for giving both a parallel and a fan-shaped fire. He it was who discovered the secret of the conical rifle ball, and he invented explosive bombs. When it is said that Leonardo understood the principles of the very modern "built-up" gun, it may well be said that this might be called his greatest title to fame as an inventor. He has left minute sketches of guns reinforced by hoops shrunk on, and even of wire guns.

The high angle mortar shown in our engraving is one of the most curious of military engines illustrated in Leonardo's manuscript. It is taken from the "Codex Atlanticus," which is now in Milan. Like all of Leonardo's sketches, it is accompanied by notes written backward in a crabbed hand. He divides the ordnance question into fortress, siege, field and marine ordnance, and the mortars shown belong to the class of siege pieces. In principle they resemble the mortars which form the subject of our first page engraving. They are stumpy mortars mounted on trunnions, and are elevated or depressed by means of a quadrant in which pins are inserted which mesh with the worm, which is actuated by the handles at the end of the shaft, as shown by the small detail drawing. These short cannon were known literally as "throwing kettles," and were intended to hurl explosives and burning shot. Hollow shot could be used with these devices, as is shown by the left half of the drawing, which we do not illustrate.



MORTAR BATTERY INVENTED IN THE FIFTEENTH CENTURY BY LEONARDO DA VINCI.

Handwriting and Forgery.

BY DR. GEORGE H. JOHNSON.

The attention of the world has recently been attracted to the subject of forgery by the Dreyfus trial in Paris and the suit of Jay vs. Sykes in London. In the latter case, Sir Tatton Sykes, a rich baronet of Yorkshire, was the nominal defendant, but, so far as the public was concerned, Lady Sykes was the real defendant. The evidence led to the dreadful conclusion that she had forged her husband's name to promissory notes amounting to $75,000, which she had sold to the notorious usurer David Jay, who, as plaintiff in the suit, was trying to enforce payment of these notes. All knowledge of the notes was denied by Sir Tatton, and the experts showed that the signatures were forged and probably by a woman; hence the verdict was for the defendant. Now Lady Sykes must stand trial on the criminal charge of forging those notes, the proceeds of which she used in betting at horse races and in stock speculations.

The forging of checks, notes, orders, accounts, etc., is called commercial forgery. The forgery of works of prose and poetry by putting the name of some known author on a work he has not written is called literary forgery. These two classes of forgery are entirely distinct, of course, and each has been practiced systematically as well as sporadically. A prominent detective once wrote an article for a popular review under the title "Forgery as a Profession." Forgery as a means of livelihood, and still more frequently as a means of gaining competence or wealth without work, has been assiduously practiced by many men. This criminal practice, again, has created a demand for experts in the detection of forgery, so that the critical examination of handwriting, paper and ink has become a profession.

The examination of literary form and vocabularies is also expert work which has been carried to a great length by the so-called higher critics. Many threatening and scurrilous letters are sent through the mails, contrary to the law, and in these cases the services of both classes of experts may be needed to determine the author of the letters.

Mr. D. T. Ames, who is an acknowledged expert on handwriting, says: "Of all the fourteen hundred millions of human beings on the earth, undoubtedly no two are identically the same in their personality, but we venture to say that there are much closer approximations in this respect than there are between the handwriting of any two persons." The handwriting of pupils under one teacher sometimes closely resembles each other, but everyone knows that the penmanship acquired at school rapidly undergoes changes for a few months after leaving school. The personality of the writer appears. The circumstances and environment of the penman, and his dominant object in writing, all play important parts in the evolution of a handwriting which soon becomes sufficiently fixed to be recognized among thousands for years after. So many muscles and nerves are exercised, even in the plainest handwriting, that it is obviously extremely improbable that two individuals should make all the motions in the same way. Indeed, it is practically impossible that any one should write his own name twice in fine lines so that one can be superposed on the other. The existence of such a coincidence of form is always an evidence that one or both have been traced, and there can be no better circumstantial proof of forgery.

Every letter of the alphabet, wherever written, may be examined for the following characteristics: Size, shading, position relative to the horizontal line, inclination relative to the vertical line, sharpness of the curves and angles, proportion and relative position of the different parts, and elaboration or extension of the extremities. In scarcely one of these particulars can a man make two letters so much alike that they cannot be distinguished by microscopical examination. Still less can a forger, with different ink and paper, duplicate a single letter. Now, when letters are joined in words the difficulty of precise duplication without tracing or photography is vastly increased, so that no microscope is needed to distinguish the differences between the original and the copy.

Although a man may write his name a thousand times and have no two signatures alike, yet, if he writes naturally and rapidly, each will have so many characteristics in common with all the others that it is very difficult for even a skillful forger to imitate any one so perfectly that an expert cannot detect it. This is particularly true if the writing is legible and produced with a free forearm motion. Yet a forger can easily produce the same general pictorial effect, so that the paying teller of a bank, when his suspicions are not aroused, may accept it without question. Sometimes the imitation is so good that a man cannot tell his own signature from the forgery, when he knows that one of them is a forgery. In such cases the expert examiner is called in. The expert declines to make an immediate decision from the general appearance, as bankers are accustomed to do; on the contrary, he subjects every word and letter to a severe examination and analysis which is just as scientific in its way as a chemical analysis of any compound.

Some of the principal tests applied to determine the genuineness of handwriting are these: The actual and relative slant of the letters, or the angles between their stems and the base; the constancy and accuracy with which a straight line is followed as a base; the amount of pressure used on the pen and the part of the stroke where it is applied, and the positions of the lines as a whole relative to the edges of the paper. The simplest punctuation mark under the microscope has its own individuality. It would be difficult to find two writers whose semicolons and quotation marks cannot be distinguished at a glance. The dotting of i and crossing of t afford an infinite number of relations between points and lines, and in both of these the time element and the freedom of muscular movement play important parts. Even the health and self-control of the penman, as well as the physical circumstances, show their influence on these little strokes.

Mr. William J. Kinsley, editor of The Penman's Art Journal, is another writing expert who has been employed in hundreds of cases in the United States and Canada. He says: "I firmly believe it to be an utter impossibility for one person to imitate successfully (so that the imitation cannot be determined by an expert) a page of writing of another. The person attempting the forgery should be able to accomplish the following: First, he must know all the characteristics of his own hand; second, he must be able to kill all of the characteristics in his own hand; third, he must know all of the characteristics in the hand he is imitating; fourth, he must be able to assume characteristics of the other's hand at will. These four points are insuperable obstacles, and I don't believe the forger lives who has surmounted or can surmount them."

Not only do individuals but also classes of people and nationalities have characteristic penmanship. Almost any one can tell the natural penmanship of a child from that of an adult. Men and women, the educated and the illiterate, the healthy and the sick, are likewise distinguished at a glance. Mr. Ames says the writer's nationality may also be told with considerable certainty.

Recent experiments have shown that the characteristics of writing are unchanged when the writer is hypnotized; that is to say, the hypnotized subject retains his habits of movement and consequently his natural penmanship. But when acting under suggestion, if the subject is told to write another kind of hand, or to imitate another person's signature, he will do so to the best of his ability, as he would in his normal state. When told that he cannot write on account of stiffness in his hand or because of injury to his arm, the effect of the suggestion is immediately seen in the altered and scrawling penmanship. And yet through it all individuality of penmanship is retained.

Mr. Kinsley recommends, as a signature which is most difficult to imitate, a legible writing which is produced rapidly by a forearm motion without lifting the pen from the paper. The style of signature once adopted should never be intentionally changed. Under these conditions bank tellers and others who know the signature will have no excuse for accepting a forgery. On the other hand, an illegible scrawl, such as many bank cashiers have adopted for a signature, is very easily imitated by a skillful penman. Here the general pictorial effect is what makes an impression, and it is not necessary for the forger to imitate each curve, as is the case in legible writing. As soon as all bank officers and customers realize this, the "profession" of forgery will be less profitable.

IT has been said that the streets of Athens, when the city was the center of attraction of the intellectual world, resembled those of Bulgarian and Turkish towns by their narrowness and irregularity, says The London Architect. Strangers, when they first walked along them, used to be in doubt whether they could have arrived in so famous a city. Owing to the labors of the members of the German Archæological Institute it has become certain that Athens possessed one street at least which was tolerably wide. It was laid out between the Dipylon at the wall on the northwest and the Agora, and was therefore north of the Theseion. The width of the roadway was about 10 meters, or 33 feet. As the Greeks, with all their ability, had not Macadam's shrewdness, the ancient street was made up of layers of earth, which required repairs constantly. One reason for the exceptional breadth was that originally a brook ran along one side, and when it was covered over, the additional space was allowed to increase the road.

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RECENTLY PATENTED INVENTIONS.

Engineering.

ROTARY ENGINE.—John F. McGlenn, Bowdle, South Dakota. In this engine a cylindrical casing is divided to form two chambers or cylinders in which separate pistons rotate together, there being two inlet and two exhaust ports for each compartment, and other duplicate attachments, forming practically two engines on a common shaft. At diagonally opposite points the piston has wings that work in annular spaces or steam chambers, in which are radially sliding abutments, which are moved alternately in slots in the casing, there being four steam passages leading from the throttle valve downward to conduct steam to the sides of the abutments. By reversing the throttle valve and the exhaust valves the rotation of the pistons and the engine as a whole will be reversed. There is no "dead point" in the engine, steam pressure being always on one, and, during a good part of the time, on both wings.

AUTOMATIC BOILER FEEDER.—George Johnson and Murphy F. Smith, Allenport, Pa. According to this invention a float-controlled piston carries a valve for admitting and shutting off the water to and from the boiler, the device being of simple and durable construction and designed to automatically keep the water in the boiler at a normal level. In case the pump does not act, or the water supply to the valve casing connecting with the boiler is interrupted, an alarm is operated to notify the engineer.

Railway Appliances.

REFRIGERATOR CAR. — Berthold E. Meyer, William I. Bodine and Christopher E. Rule, Springfield, Mo. To facilitate loading refrigerator cars without causing an undue waste of ice, this invention provides a car of novel construction, the car being divided into compartments designed to protect the refrigerating medium during the time when the car doors are open. The car has at each end refrigerating compartments forming ice bunkers, which run over the refrigerating compartments and down their outer ends, and closing the inner side of each compartment is a removable wall having two hinged sections, the contiguous edges of which are recessed, two doors being hinged within the recesses, while a bracket is carried by each section of the wall in which slides a gate having two hinge-connected sections. When the car doors are open, communication with the ice bunkers is closed, but when the car doors are closed, communication is opened direct with the ice bunkers to the center of the car.

Electrical.

AUTOMATIC CUT OUT.—Henry F. Blackwell, Jr., Brooklyn, N. Y. This invention relates to fuse holders to be placed in an electric circuit to automatically cut out the line in cases of excessive load. It comprises a spring-yielding arm forming a conductor and a link formed of sections joined with fusible solder, one end of the link being connected to the arm and its other end being connected to a part insulated from the arm, while a carbon point in the circuit engages with the link. The device is designed to be quick and positive in action, to effectively prevent the burning out of instruments.

Bicycles, Etc.

CHAIN GEAR CASING. — Horace W. Dover, Northampton, England. A case which may be easily applied to and detached from the chain gearing of a bicycle is provided by this invention, the case being divided at the plane of the crank and driving wheel axles into halves, which are so united that, while insuring a dust proof closure, the casing may be taken off for cleaning, oiling or repairs, and refixed in position with great facility. At its forward end the case itself fits around the bottom bracket and crank shaft, and at the rear hub provision is made for maintaining a dust-tight closure, while admitting of adjustment of the driving chain.

BICYCLE SHOULDER BRACE —David T. Singleton, Willard, Ga. To enable a rider to apply greater force to the pedals than that due to his weight is the principal object of this invention, the brace comprising wide padded hooks, which extend overthe shoulders, the longer front ends of the hooks having attached bars and a horizontal adjustable section from which depends a plate and hook for connection with a strap by which connection is made with the horizontal bar of a bicycle frame. The device is designed to be worn under the coat and vest, and the hook connecting the brace proper with the machine is automatically detachable when the rider dismounts or in case he should be thrown from the machine.

SPROCKET CHAIN.—Salvador Pastor, Paris, France. This chain, while especially applicable to bicycles, tricycles, etc., is also adapted for various mechanical applications. It has a special arrangement of link joints, the links being jointed together by an eccentric hinge joint in such a manner that the effective length of a link will be less in the parts of the chain which are in a straight line than in the parts which are curved. Each link has at one end a cammed portion and at the other end a roller on which a cammed portion rolls, whereby the positions of the links relative to each other are changed according to the position of the chain.

Elevators, Etc.

ELEVATOR SAFETY DEVICE.—John T. Taylor, New York City. Two patents have been granted this inventor for novel means for manually operating the safety clutch of a passenger or freight elevator, the improved construction facilitating the application of the clutch when the car descends too fast and the automatic apparatus fails to work. A rope normally traveling with the cab is operatively connected with a normally inactive stop mechanism, while a stationary taut rope extending through the cab carries a spring cushion adapted to be engaged by a clamp on the first rope at any time when the operator in the cab depresses a lever. According to one of the patents, an electromechanical apparatus causes the operation of the clamping segments from means within the car, and under the immediate control of the conductor.

AUTOMATIC STOP FOR HOISTS.—Francis H. Kohlbraker, Shamokin, Pa. This invention relates to an improved mechanism for stopping hoists or cages in vertical shafts or slopes to prevent their being hoisted above a certain point, thus obviating the possibility of wrecking the cage or a part of the hoisting mechanism. It comprises a power operated brake and a weighted valve-operating lever operating the valves of the engine and the brake, a tripping lever normally holding the valve-operating lever out of action, while a lever in the path of the hoist is connected with the tripping lever. The device is so located that it will not be operated if the hoist stops at the proper point, but comes into operation only when the hoist travels beyond its fixed limit.

Mechanical.

WINDING MACHINE. — Chauncey A. Cornell and Elmer S. Robison, Pittsfield, Mass. This is a machine more especially designed for winding wall paper or other endless material into rolls of any desired length, the machine working automatically and being adjustable to wind rolls of different lengths. An intermittently revolving frame carries a series of winding rollers, each adapted to receive paper in its turn, and means for rotating a roller at a time to wind up a desired length of paper when the frame is at a standstill, the feed mechanism automatically stopping when the frame is rotated, or being actuated when one of the rollers is in position to receive the paper.

TONGS.—Canly D. Eames, Worcester, Mass. These tongs are made with a changeable fulcrum to permit the operator to give a fine adjustment to peculiarly formed jaws, to cause the latter to properly grip small or large objects, but one hand being required to manipulate the lever handles to open or close the jaws. One of the lever handles has a rigid pivot with laterally projecting portion entering a slot in the other handle, the slot being formed with recess s in one of its walls adapted to be engaged by the projecting portion of the pivot.

Agricultural.

PLANTER AND FERTILIZER DISTRIBUTER.—Joseph W. Terry, Brewton, Ala. This is a light, strong and inexpensive machine, designed to open a furrow and deposit in it a fertilizing material, sow any kind of seed in any quantity and cover the seed, rolling the ground and leaving the land in good position to be cultivated, the cultivation being afterward effected by bringing into action other parts of the machine, by which a growing crop may be fertilized and cultivated in a most efficient manner. The machine may also be used for sewing seed broadcast, if desired.

HOLDING SHOVELS ON CULTIVATOR SHANKS.—Vesper A. Gleason, South Riverside, Cal. To facilitate attaching the teeth or shovels to the cultivator standard or beam is the object of this invention, according to which an adjustable wedge or key, with a spring-locking device attached to its shank, is adapted to engage the slotted shovel shank, there being means for holding the wedge or key at the desired adjustment. By simply lifting a pawl the key may be moved into and out of engagement with the shanks of the shovels, the work being accomplished in the time one would ordinarily be looking for a wrench. The key is also adapted for use in securing plow points and shares in position.

REMOVING PITH FROM STALKS. — George R. Sherwood, Kearney, Neb. As stalks free from pith afford a valuable food which may be fed directly to stock, while ordinarily the stalks cannot be advantageously so used except for a short distance from the tip, this inventor has devised a machine for removing the pith in a simple and efficient manner. As the stalks are fed to the feed rollers, they pass a splitting knife by which they are divided into halves, when they are received by guide plates at the rear of which are spring-pressed pressure plates co-operating with pith-removing wheels, a conveyer receiving and discharging the pith at the side of the machine.

PORTABLE GRAIN ELEVATOR.—Isaac A. Milton, Bigelow, Minn. To lessen the labor of the farmer in moving grain from the thrasher to the granary, and save a large amount of manual labor, is the object of this invention, according to which the body of the elevator consists of a hopper supported in a wheeled frame, the elevator folding down when not in use, but being so constructed that it will receive and elevate grain through a valved opening when the leg is set up or inclined. When a horse power is used to drive the elevator carrier, it may be economically driven by detaching the team from the wagon and attaching it to the horse power.

SAUSAGE MEAT CHOPPER.—Alexander S. Stewart, Neche, North Dakota. To cut meat fine for sausages and other purposes, this inventor provides a mechanism whereby the knives have a rocking reciprocating movement, the knives being readily adjustable, and means being provided whereby any desired pressure may be given to the knives. When the knives encounter a bone or other hard substance they yield correspondingly, and provision is made to prevent the clogging of the knives by the meat.

Miscellaneous.

NON-REFILLABLE BOTTLE. — Otto G. Ogden, Louisville, Ky. According to this invention, a simple and inexpensive valve mechanism is fitted in the neck of the bottle to allow the free outward passage of the original contents of the bottle, but prevents its refilling. The bottle neck has an inner annular channel, into which expands a spring or locking ring on the valve casing, holding the latter in position, and in the casing is a plug guard having enlarged end portions provided with outlet ports, a regulating valve being pivoted to the outer end of the guard and the valve being wholly within the bottle neck. The lower end of the valve casing has a central opening controlled by a flap valve, which cannot be reached by a wire or other instrument to open an inlet passage.

CASH REGISTER.—Horace Bradt and Jefferson Kindleberger, San Diego, Cal. To facilitate registering the amount of current sales, and to add the amount so that the total may be seen at the close of the day or at any time desired, is the object of this invention, which provides a machine with but few parts and of simple construction, which discloses to the purchaser the sum paid, and also registers the number of times the lid of the casing shall have been opened, or the cash drawer opened. A duplicating memorandum strip is also provided in connection with the casing of the machine, and an alarm is sounded when the cash drawer is opened, if desired.

VENTILATED BARREL.—Wilmer B. East, Norfolk, Va. This invention provides a barrel for the transportation of fruit, vegetables, etc., made of a novel form of veneer blanks, the barrel having its sides composed of inner and outer sheets provided with diagonal slits. The inner and outer layers are arranged with their slits reversed, the slits of one inclining in one direction and those of the other in the opposite direction, the slits of one layer or sheet crossing those of the other. The slits do not extend out to either edge of the blank, the edge portions being left unsevered and forming the chines of the barrel, which is provided at its ends with inner and outer hoops.

SHOE PROTECTOR.—John O. Sharpless, Fairhaven, Wash. To protect and save from wear a boot or shoe at the vamp or sides when the wearer is coasting, this invention provides a shield having a marginal flange engaging the bottom of the sole, spring wires extending from the upper edge of the shield down under the shank, where they are crossed and brought to engagement up over the back of the quarter at the rear of the heel, thereby effectually holding the shield upon the shoe, but permitting of its convenient detachment when desired.

KNIFE.—Victor M. Fowler, Acton, Mass. This is a cheap and inexpensive knife for slicing bread and cake or slicing vegetables, etc. To the handle is attached a frame from which extends the blade, the handle also carrying an adjustable guide arm parallel with the blade. The guide arm extends slightly below the cutting edge of the blade, and is adapted to be placed with its inner face against the face of the bread or other article to be sliced to guide the knife edge so as to cut a slice of the desired thickness. Where the guide arm is made shorter than the knife blade, the outer end of the latter is adapted for paring, coring, etc.

STEAM COOKER. — Lewis F. Culver, Harvey, Ill. This is a cooking apparatus designed to require but a low degree of heat, and in which the steam is condensed so that a small quantity of water will suffice by being used over and over, the water in the reservoir being used, not only as a supply for the boiler, but as a condenser through which all the steam generated must afterward pass. The reservoir is located alongside the body or steaming chamber, there being means for protecting the bottom of the reservoir from heat, and connections between the reservoir and steaming chamber. The cooker has double walls forming insulated sides, preferably packed with non-heat-conducting material.

DISH CLEANER. — Charles Fellows, Pittsburg, Pa. According to this invention, an elongated tank is divided into a main washing compartment and a supplemental rinsing compartment, there being in the bottom of the tank a steam coil, and in its top edges bearings from which, in the washing compartment, are suspended swinging hangers carrying a basket in which the dishes to be washed are placed. One of the hangers is connected by a pitman with a crank disk outside of the tank at one end, whereby the basket may be reciprocated in the tank by any suitable power until the dishes have been washed, when the basket is lifted out, with its dishes, and submerged in the rinsing compartment.

GARMENT HANGER.—Peter Cummings and Michael Wankerl, Canajoharie, N. Y. This device has a fastening block to be secured by screws to a base block, and from the fastening block spring loops adapted to support a coat extend downward and outward, while two additional upper loops extend downward and outward, the device being especially designed for holding hats and coats.

BATHING SUIT.—Jesse W. D. Davis, Lampasas, Texas. This suit comprises a shirt of waterproof material, having openings for the ingress of water, a diaphragm in its lower portion having openings for the egress of water, while straps hold the diaphragm in conical form. The suit is inexpensive, effectually prevents exposure of the person, may be easily and quickly dried and will not cling to the bather.

Designs.

HOE. — Frank H. Foster, Honolulu, Hawaii. The side edges of this hoe, near the eye which receives the handle, have elongated teeth, while the front of the blade presents a broad surface with untoothed side edges.

HAIR-PIN.—Victor F. and Marguerite Maidhof, New York City. The legs of this hair-pin are round, and throughout the length of each is a series of depressions, forming longitudinal undulating surfaces.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS, ETC.

INFORMATION RELATING TO DRAWINGS TO ACCOMPANY APPLICATIONS FOR PATENTS IN ALL THE PRINCIPAL COUNTRIES. Washington, D. C.: The Norris Peters Company. Pp. 32. Third edition, 8vo.

The company are contractors with the United States Patent Office for the Official Gazette, copies of drawings of patents, trade marks and designs. It contains two reproductions of United States patent drawings on linaura fabric and bristol board. It also gives all of the countries in which patents are issued, with the rules and regulations regarding the drawings for patents, It gives valuable information in concise form.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7393) W. K. W. asks: 1. Why is belted governor objectionable in regulating speed of dynamo engine? A. A belted governor is not reliable. The belt creeps irregularly under variation of speed in the governor and has unequal tension from variation in the moisture of the engine room. It is also liable to slip and more liable to accident than gear-driven governors. 2. Give in detail the precautions necessary, in running an electric lighting plant, to maintain the efficiency of the plant, as to economy and regularity of output. A. Crocker & Wheeler's "Care and Management of Dynamos and Motors" will furnish you information. Price $1 by mail. 3. Should it become necessary to reverse the direction of rotation of the armature because of the location of the dynamo, describe what steps would be necessary. A. See pages 44 and 45 of book referred to above under 2. The cases are too many to reprint. Many dynamos, but not all, may be run in the opposite direction by simply reversing the brushes.

(7394) C. W. M. asks: 1. What is the meaning of consequent poles as applied to a dynamo? A. A dynamo has consequent poles when the field spools are so wound that two south or two north poles are formed next each other. This is always the case in dynamos with four field coils so placed that two connect with and magnetize one pole piece and the other two in the same way magnetize the other. 2. What is meant by the term unipolar dynamo? Can there be existent one magnetic pole without the other? A. The name unipolar was given to machines which produce a continuous current without a commutator. There is no such thing existing separately as a single magnetic pole. The word applied to a dynamo is a misnomer. These machines have gone out of use. Their voltage was low and they could only be used for electroplating. In these machines a coil or other movable conductor slides around one pole of a magnet and cuts the magnetic lines in a continuous manner without reversals of the induced current. Faraday's disk is such a machine. See Silvanus P. Thompson's "Electricity and Magnetism," sections 469 and 227.

(7395) A. K. D. writes: 1. I have made the 8 light dynamo described in SUPPLEMENT, No. 600, which works well with a few exceptions. One is it sparks quite a little at the brushes, using ¾ inch carbon brushes. A. A very common cause of sparking at commutator is that the brushes are not set at the proper point. Rotate to different position and find point of least sparking. Dynamo troubles are well treated in Crocker & Wheeler's "Practical Management of Dynamos and Motors," price $1 by mail. It is a book indispensable to any one having charge of a dynamo. 2. The other is, if I put about 20 ohms resistance between one brush and field (of No. 36 copper wire, which is all I had at hand) it will burn out for me. This, of course, I think is too fine. Now, if wire will do for a resistance, what size and how much must I use? Also, how can I prevent that sparking? Have connected it up as described under diagram No. 18. A. Your field resistance must have a wire heavy enough to carry the current. Copper wire is scarcely suited to this use. Iron or German silver should be employed. About 10 ohms are required for the field regulator in your case. Use No. 12 iron wire. This is about 1,200 feet. 3. Cannot the dynamo be wound, or perhaps only the armature, to give off a 110 volt current? How many lamps, and what amperage would it be? A. For 110 volts: Wind armature with No. 24 A. W. G. copper wire. 25 turns in

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each of the 24 coils. The same field can be used with an external resistance of 75 ohms as a regulator. 4. I have also made one cell of storage battery, called a practical storage battery by P. B. Warwick; made it just as described by the writer. Used asbestos between the plates about three-sixteenths inch. The battery is to have passed through it a current of 10 amperes for 48 hours, then to be finished. Have only had chance to pass that current through for a few hours, in which time enough was accumulated to ring a bell even two hours after I stopped, but finally it would disappear. Now, is there something wrong with the battery or is it likely to do that as long as it has not the forty eight hour treatment, or will it do it even after that? A. You have not yet formed the plates of your storage cell. This is done by charging for a long time and then discharging. This repeated several times brings the material into a condition for use. Follow carefully the directions given in the book you are using. You cannot otherwise expect success.

(7396) L. G. S. writes: 1. In reading the directions for making motor, No. 641 SCIENTIFIC AMERICAN SUPPLEMENT, it says in one place to use No. 18 cotton covered copper magnet wire for armature coils and in the dimension list it says No. 16 for both armature and field coils. Which is right? A. No. 18 is the correct size for armature of motor No. 641. The same size of wire is not employed on both field and armature. That of the armature is the finer, so as to get more turns in the spaces for the coils. 2. Can this motor be made or transformed into a dynamo, and how? A. Such a motor is a dynamo. If run by power up to the speed at which it turns as a motor, it will yield a current about the same as turns it as a motor. 3. I have a copy of "Experimental Science," by Hopkins, at hand, or, at least, in the public library. Is there a battery described in this book that will run the motor? A. The plunging bichromate battery is intended for this purpose. It is fully described in "Experimental Science" and in SCIENTIFIC AMERICAN SUPPLEMENT, No. 792, price 10 cents by mail. 4. Can you give me the number of any SCIENTIFIC AMERICAN or SCIENTIFIC AMERICAN SUPPLEMENT describing and with directions for constructing an electroplating outfit or process? A. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 310, 1032, 1078; Watts' "Electrometallurgy," $1; Bonney's "Electroplater's Handbook," $1.20.

(7397) R. S. C. asks: Which conveys the most electricity, a tube or a rod, provided the diameters are the same? Our text books state that electricity resides merely on the surface of a body. According to that theory, the teacher holds that the quantity would be the same, while some of the pupils think that, as there is an outer and an inner surface to a common tube, the tube would convey the most. Would not a tube be the same, if cut and rolled out, as a plate, it having two surfaces? Or is the theory given in our text books (Wells and Coolies) false? A. Your people seem to be talking about different things without knowing it. An electric current, as from a battery, or electric light dynamo, flowing through a wire uses all the metal inside and outside. A tube will not carry this as well as a solid rod of same size. Far from it. But an electric charge, as from rubbed paper, cat skin or a Holtz machine, is only on the surface of the metallic conductor, where it is held by the insulation, since it is self-repellent, and therefore only a thin layer of metal is needed to hold it. Cover a non-conductor with tinfoil and it will hold as heavy a charge as if it were a solid ball. Lightning acts in the same way, and in its awful speed does not penetrate the metal rod over which it rushes. A tube or small wire is usually better than a heavy rod for a lightning conductor, though this is not the whole reason why.

(7398) J. T. C. asks: 1. What is ebonite? A. It is the same as hard rubber. 2. Is ebonite better than plate glass to use for plates of machine? I wish to use two plates 16 inches diameter. A. It may be rotated more rapidly than glass without breaking. 3. Would ⅛ inch thick, 16 inches diameter hard rubber plates be the best kind I could get to construct this machine? A. It would be strong enough.

(7599) C. C. A. asks: 1. How much wire would it take to wind field core, also armature? A. For field use No. 26 A. W. G. single cotton covered wire, 700 feet, about 5½ pounds. For armature use No. 18 A. W. G., 100 feet, about ½ pound. 2. In the small 20 light Edison dynamo armature are the end washers (or flanges) to be of brass or iron? A. The end washers or flanges for armatures should not be of iron, in order to prevent the eddy currents from completing a circuit through them.

(7400) F. J. H. asks: 1. Will you kindly say what I can use as most impervious insulation of magnetism? A. The only substance which will act as a screen for magnetism is iron. Surround a space with a thick shield of iron and magnetism cannot penetrate it. 2. An ordinary horse shoe magnet made from ⅛×1 inch bar, if, beginning ½ inch from the ends of the prongs, they are tapered to 1/16×1 inch, will the magnetic power remain unchanged? A. A magnet is stronger, that is, will hold up more, when it is tapered to its ends.

(7401) P. K. & Company write: Kindly furnish us with a recipe or formula for making a cement suitable for use in an aquarium. A. Linseed oil, 3 ounces; tar, 4 ounces; resin, 1 pound; melt together over a gentle fire. If too much oil is used, the cement will run down the angles of the aquarium; to obviate this it should be tested before using by allowing a small quantity to cool under water; if not found sufficiently firm, allow it to simmer longer or add more tar and resin. The cement should be poured in the corners of the aquarium while warm (not hot). This cement is pliable, and is not poisonous.

(7402) J. B. asks: If I run electric wires through trees, and the limbs rub the covering off the wires, and when it rains the water lies on the wire on the bark, will it injure the tree, or will it reduce the power in the electric light in the lamps? A. Electric light wires should not be allowed to rub against any tree, post or anything else so as to remove the insulation. The leakage is a loss, even if no other harm is done. In wet weather, if the line is an arc light line of high potential, or carries an alternating current, a person coming in contact with such a tree or post might receive a severe shock.

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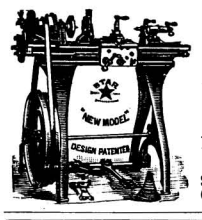

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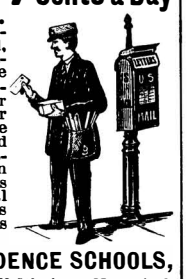

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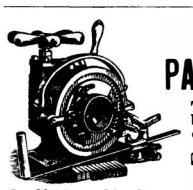

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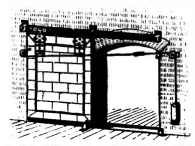

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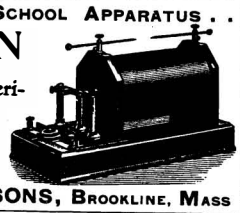

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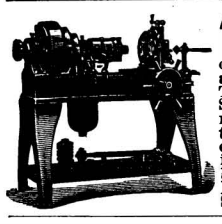

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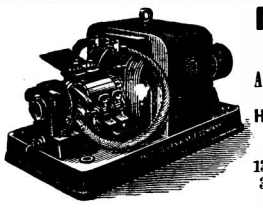

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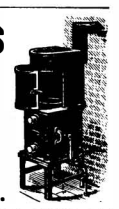

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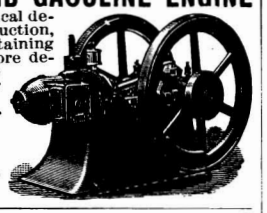

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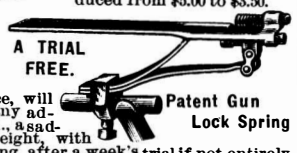

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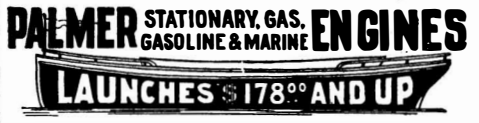

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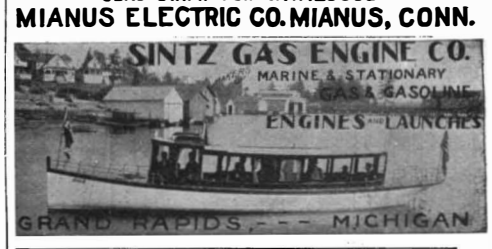

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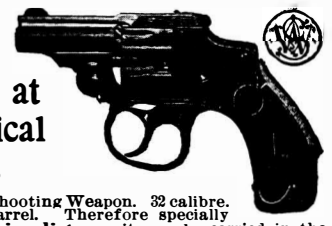

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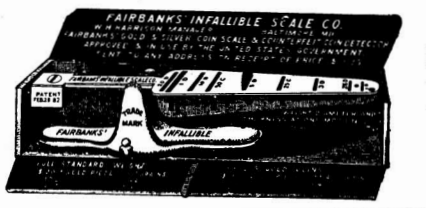

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